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August 15, 1986

Energy Research Abstracts

Abstracts 33493-35392

Office of Scientific & Technical Information
UNITED STATES DEPARTMENT OF ENERGY

CURRENT AWARENESS PUBLICATIONS ON ENERGY

To provide complete coverage of literature related to major Department programs, announcement publications that are comprehensive in their coverage of certain energy fields are issued regularly. All information in these publications, plus additional backup information, is included in the Energy Data Base of the Office of Scientific and Technical Information; all references are also available for machine searching via the on-line retrieval system, DOE/RECON, and the commercial on-line retrieval systems. Descriptions of these current awareness publications, which are supported either directly or indirectly by the DOE, appear below. Department of Energy components may receive the listed publications free from the Office of Scientific and Technical Information, U. S. Department of Energy, P. O. Box 62, Oak Ridge, TN 37831. Telephone (615) 576-1301; FTS 626-1301.

PUBLICATIONS OF THE OFFICE OF SCIENTIFIC AND TECHNICAL INFORMATION

Energy Abstracts for Policy Analysis (EAPA)

A monthly abstract journal devoted to the analysis of energy research, conservation, and policy. Scope and coverage are limited to substantive articles or reports and emphasize legislative, regulatory, and other legal aspects, as well as social, economic, and environmental impacts. *EAPA* is available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The annual subscription price is $72.00 for domestic (North America) or $90.00 for foreign (outside North America) subscribers; a single issue is $5.00 or $6.25, respectively.

Energy Research Abstracts (ERA)

A comprehensive semimonthly abstract journal devoted to all areas of energy-related information produced by the Department of Energy, other U. S. government organizations, and foreign governments. *ERA* is available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The annual subscription price for the 24 issues is $146.00 for domestic (North America) subscribers or $182.50 for foreign (outside North America) subscribers. A single issue is $14.00 or $17.50, respectively.

DOE Patents Available for Licensing (PAL)

DOE is prepared to grant exclusive or nonexclusive, revocable licenses under DOE-owned U. S. patents and patent applications; this semiannual publication provides abstracting and indexing coverage of this literature. *PAL* is available (use PB86-946800) from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161. The annual price is $18.00 for domestic (North America) or $36.00 for foreign (outside North America); a single issue is $9.00 or $18.00, respectively.

Energy Meetings (EM)

A monthly listing of conferences, symposia, workshops, etc., pertaining to DOE's programmatic interests. *EM* is available on subscription (use PB86-901500) from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161. The annual subscription price is $45.00 for domestic subscribers and $90.00 for subscribers outside the North American continent; a single issue is $5.00 and $10.00, respectively.

The following monthly update journals are available to the public on subscription from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161; use the identifying order number (PB- No.) when subscribing. The annual subscription price (12 issues plus cumulative index) is $85.00 for domestic (North America) and $170.00 for foreign (outside North America) subscribers; a single issue is $8.00 and $16.00, respectively.

Current Energy Patents (CEP)–**PB86-902800.** International patent literature, including patent applications, on any aspect of energy production, conservation, and utilization.

Energy and the Environment (EAE)–**PB86-914900.** Impacts of energy-related activities and radioactive and nonradioactive pollutants on the environment.

Fossil Energy Update (FEU)–**PB86-914600.** The exploration, development, processing, and use of fossil fuels.

Fusion Energy Update (CFU)–**PB86-915300.** Information on controlled thermonuclear fusion, including plasma and fuel research and power plant engineering and conceptual design studies.

Solar Energy Update (SEU)–**PB86-914500.** The utilization of solar energy, including biomass and tidal and wind power.

The following semimonthly bulletins are also available from the National Technical Information Service. The annual subscription rate for one volume (calendar) year (24 issues; no indexes) is $45.00 for domestic (North America) and $90.00 for foreign (outside North America) subscribers; use the identifying order number (PB- No.) when subscribing.

Acid Precipitation (APC)–**PB86-901000.** Acid precipitation, including effects and possible control measures.

Buildings Energy Conservation (BEC)–**PB86-900700.** Technology required for energy conservation in buildings of all types.

Coal-Based Synfuels (CBS)–**PB86-901400.** Conversion of coal into gaseous or liquid fuels.

Coal Combustion and Utilization (CCU)–**PB86-914400.** Coal combustion, including fluidized bed combustion, and direct utilization of coal for power generation, fuel cells, and MHD generators.

Coal Preparation and Pollution Control (CPC)–**PB86-900800.** Coal preparation and cleaning and reducing pollution from its direct combustion.

Direct Energy Conversion (DEC)–**PB86-946600.** Photovoltaics, magnetohydrodynamics, electrohydrodynamics, thermoelectrics, thermionics, and fuel cells.

Energy from Biomass (EFB)–**PB86-900600.** Biomass production, conversion, and utilization for energy.

Geothermal Energy Technology (GET)–**PB86-914700.** Exploration, development, and utilization of geothermal resources.

Heavy-Ion Reactions (HIR)–**PB86-900500.** Heavy-ion (A > 4) reactions.

Laser Research (LAR)–**PB86-901100.** Laser research and development, excluding applications.

Nuclear Fuel Cycle (NFC)–**PB86-913400.** Both front and back ends of the nuclear fuel cycle.

Nuclear Reactor Safety (NRS)–**PB86-913500.** Accident analysis, safety systems, radiation protection, decommissioning and dismantling, and security measures.

Radioactive Waste Management (RWM)–**PB86-902900.** Management aspects of transport and storage, waste processing, waste disposal, waste storage, radioactive effluents, and shipping containers.

Solar Thermal Energy Technology (STT)–**PB86-901200.** Research and development of efficient and reliable solar thermal conversion systems.

Transportation Energy Research (TER)–**PB86-900900.** Energy-efficient advanced automotive propulsion systems and transportation energy conservation.

Unconventional Petroleum (UCP)–**PB86-901300.** Secondary and tertiary recovery of petroleum and oil shales and tar sands.

INTERNATIONAL ENERGY PUBLICATIONS

The Office of Scientific and Technical Information (OSTI) cooperates in the publication of international abstract journals with the following: (1) International Atomic Energy Agency, International Nuclear Information System, Vienna, Austria, for *Atomindex;* (2) International Energy Agency, Biomass Conversion Technical Information Service, Dublin, Ireland, for *Biomass Abstracts;* and (3) International Energy Agency, IEA Coal Research, London, England, for *Coal Abstracts.* In each case, the cognizant foreign agency provides the non-U. S. information to OSTI for inclusion in the Energy Data Base; in turn, OSTI provides the U. S. information for input into the respective journal.

Atomindex

A semimonthly abstract journal providing worldwide coverage of information on nuclear science and technology. *Atomindex* is available by subscription from UNIPUB, 345 Park Avenue South, New York, NY 10010. The cost of an annual subscription, 24 semimonthly issues and semiannual and annual cumulative indexes, is $290.

Biomass Abstracts

A bimonthly abstract journal with comprehensive coverage of information on the conversion of biomass to energy. *Biomass Abstracts* is available free to DOE components and contractors from OSTI. Non-DOE organizations may obtain *Biomass Abstracts* from Biomass Conversion Technical Information Service, Institute for Industrial Research and Standards, Ballymun Road, Dublin 9, Ireland, for 42 IR pounds per year. Make checks payable to the Institute.

Coal Abstracts

A monthly abstract journal providing comprehensive worldwide coverage of information in the field of coal science and technology. *Coal Abstracts* is available to DOE components and contractors from OSTI. Non-DOE organizations may obtain *Coal Abstracts* from IEA Coal Research, Technical Information Service, 14-15 Lower Grosvenor Place, London SW1W 0EX, England, for 100 pounds sterling per year.

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NOTICE

The 1985 Annual Indexes of *Energy Research Abstracts* (Volume 10) are available on microfiche. The four indexes may be ordered separately or as a set via the following codes and order numbers.

Index	Code	Price	Order No.
1. Corporate Author	A01	$5.95	DE86011193 (494p.)
2. Personal Author	E01	$7.50	DE86011194 (1061p.)
3. Contract Number, Report Number and File No. Correlation	E01	$7.50	DE86011195 (965p.)
4. Subject	E06	$18.00	DE86011196 (3002p.)
5. Set (all 4 indexes)	E12	$33.00	DE86011197 (5522p.)

DOE offices and contractors may order from the DOE Office of Scientific and Technical Information, P.O. Box 62, Oak Ridge, TN 37831; others should order from the National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161.

AND

Printed copies of the indexes are available from the Superintendent of Documents, U. S. Government Printing Office, Washington, DC 20402. The price of the set is $124.00, and the sales stock number is S/N 061-000-00675-3.

*Note: Codes, microfiche prices, sales stock number, and price of printed set must be obtained from NTIS.

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ENERGY RESEARCH ABSTRACTS

ABOUT THE OFFICE OF SCIENTIFIC AND TECHNICAL INFORMATION

The Office of Scientific and Technical Information (OSTI) in Oak Ridge, Tennessee, has been the national center for scientific and technical information for the Department of Energy (DOE) and its predecessor agencies since 1946. In developing and managing DOE's technical information program, OSTI places under bibliographic control not only DOE-originated information but also worldwide literature on scientific and technical advances in the energy field and announces the source and availability of this information. Whereas the literature of science is emphasized, coverage is extended to DOE programmatic, socioeconomic, environmental, legislative/regulatory, energy analysis, and policy-related areas. To accomplish this mission, OSTI builds and maintains computerized energy-information data bases and disseminates this information via computerized retrieval systems and announcement publications such as abstracting journals, bibliographies, and update journals. Direct access to OSTI's most comprehensive data base, the Energy Data Base, is available to the public through commercial on-line bibliographic retrieval systems. The Energy Data Base and many of OSTI's energy-related data bases are available to DOE offices and contractors and to other government agencies via DOE/RECON, the Department's on-line information retrieval system. The Office of Scientific and Technical Information has developed and maintains systems to record and communicate energy-related research-in-progress information, to maintain a register of DOE public communications publications, to track research report deliverables from DOE contractors, and to test and make available DOE-funded computer software programs with scientific and management applications; OSTI also serves as adviser for special publication needs of the Department. To effectively manage DOE's technical information resources, OSTI's program is one of continual development and evaluation of new information products, systems, and technologies.

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ABOUT *ENERGY RESEARCH ABSTRACTS*

Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U. S. Department of Energy, its laboratories, energy centers and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. The user should remain aware that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.

ERA is comprehensive in its subject scope, encompassing the DOE's research, development, demonstration, and technological programs resulting from its broad charter for energy sources, supplies, safety, environmental impacts, and regulation.

ERA is available on an exchange basis to universities, research institutions, industrial firms, and publishers of scientific information. Inquiries should be directed to the Office of Scientific and Technical Information, P. O. Box 62, Oak Ridge, TN 37831.

ERA is available to the public on a subscription basis from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The subscription rate for the 24 semimonthly issues is $146.00 for domestic subscribers and $182.50 for foreign subscribers. A single issue costs $14.00 (domestic) or $17.50 (foreign). The cumulative indexes will be available in printed form from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The GPO Stock Number is 061-000-00675-3 and the price is $124.00 for the Vol. 10 indexes. The cumulative indexes are also available in microfiche form from the National Technical Information Service, U. S. Department of Commerce, Springfield, VA 22161, and from Engineered Systems, P. O. Box 866, Oak Ridge, TN 37831.

Office of Scientific and Technical Information
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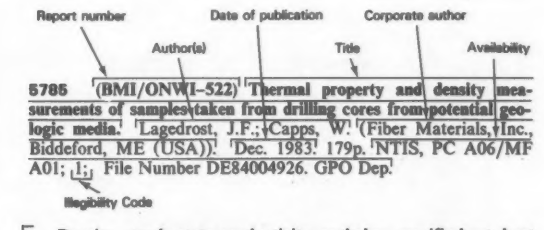
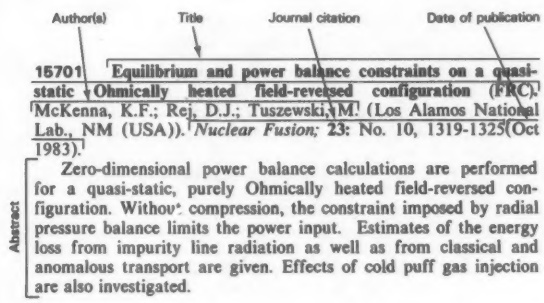
HOW TO USE *ENERGY RESEARCH ABSTRACTS*

ABSTRACTS IN *ENERGY RESEARCH ABSTRACTS*

The principal elements of abstract entries for a typical research and development report and a typical technical journal article are illustrated below.


Report number
Date of publication
Corporate author
Author(s)
Title
Availability
5785 (BMI/ONWI-522) Thermal property and density measurements of samples taken from drilling cores from potential geologic media. Lagedrost, J.F.; Capps, W. (Fiber Materials, Inc., Biddeford, ME (USA)). Dec. 1983. 179p. NTIS, PC A06/MF A01; 1; File Number DE84004926. GPO Dep.
Legibility Code
Abstract
Density, steady-state conductivity, enthalpy, specific heat, heat capacity, thermal diffusivity and linear thermal expansion were measured on 59 materials from core drill samples of several geologic media, including rock salt, basalt, and other associated rocks from 7 potential sites for nuclear waste isolation. The measurements were conducted from or near to room temperature up to 500°C, or to lower temperatures if limited by specimen cracking or fracturing. Ample documentation establishes the reliability of the property measurement methods and the accuracy of the results.


Author(s)
Title
Journal citation
Date of publication
15701 Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC). McKenna, K.F.; Rej, D.J.; Tuszewski, M. (Los Alamos National Lab., NM (USA)). Nuclear Fusion; 23: No. 10, 1319-1325 (Oct 1983).
Abstract
Zero-dimensional power balance calculations are performed for a quasi-static, purely Ohmically heated field-reversed configuration. Without compression, the constraint imposed by radial pressure balance limits the power input. Estimates of the energy loss from impurity line radiation as well as from classical and anomalous transport are given. Effects of cold puff gas injection are also investigated.

INDEXES TO *ENERGY RESEARCH ABSTRACTS*

Five indexes are provided for approaching the contents of each issue of *Energy Research Abstracts (ERA)*. Each index is preceded by an introduction that details the organization of the index and the principles by which it was compiled. The reader is referred to these introductions for information not found in the index examples that follow.

● Corporate Author Index

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

5785 (BMI/ONWI-522) Thermal property and density measurements of samples taken from drilling cores from potential geologic media. Lagedrost, J.F.; Capps, W. **(Fiber Materials, Inc., Biddeford, ME (USA)).** Dec. 1983. 179p. NTIS File Number DE84004926. GPO Dep.

is indexed as:

Fiber Materials, Inc., Biddeford, ME (USA)

● Personal Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

Capps, W., *See* Lagedrost, J. F.
Lagedrost, J.F., Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
McKenna, K.F., Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;US)
Rej, D.J., *See* McKenna, K.F.
Tuszewski, M., *See* McKenna, K.F.

● Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

SALT DEPOSITS
Density
Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
REVERSED-FIELD PINCH
Energy Balance
Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9: 15701 (J;AT)

● Contract Number Index

DOE technical report literature is indexed using contract numbers. This index contains the contract number with corresponding abstract and report numbers.

AC06-76RL01830 **Fiber Materials, Inc., Biddeford, ME (USA)**
9:5785 BMI/ONWI-522

● Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. Patents and conference papers are indexed here as a matter of convenience. When a report is supplied under a File Number, that number is included in the availability statement. A file number–report number correlation is included for convenience.

BMI/ONWI-522 9:5785 NTIS, PC A09/MF A01. File Number DE84004926, Distribution Category MN-70

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Much of the information is provided by (1) bilateral exchange agreements with foreign organizations, and (2) exchange agreements or contracts with other U. S. government agencies, private firms, or institutions.

Foreign Sources

CEA Centre d'Etudes de Saclay
GIF-sur Yvette Cedex, France

Fachinformationszentrum
Energie, Physik, Mathematik GmbH
Karlsruhe, Federal Republic of Germany

IEA Biomass Conversion Service
Dublin, Ireland

IEA Coal Research
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National Aeronautics and Space Administration
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Springfield, VA

National Institutes of Health
National Library of Medicine
Bethesda, MD

NOVA Information Services Company
Commack, NY

Plenum Publishing Corporation
New York, NY

University of Tennessee
Graduate School of Library and Information Sciences
Knoxville, TN

Communication concerning the editorial policy and content of *Energy Research Abstracts* should be addressed to the Editor, *Energy Research Abstracts,* Office of Scientific and Technical Information, P. O. Box 62, Oak Ridge, TN 37831.

SUBJECT CONTENTS (NUMERICAL LISTING)

Six-digit subject category numbers are used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's computerized bibliographic information system. The six-digit category numbers are utilized as if they were three pairs of two-digit numbers, the first two pairs being used to arrange the abstract content of *Energy Research Abstracts*. The following listing includes the totality of the 39 first-level and 293 second-level subject categories used. Because each issue of *ERA* announces only those documents becoming available during a semi-monthly period, some subject categories may not be represented in every issue. The complete subject category scheme with scope definitions and limitations is available as DOE/TIC-4584-R6 from NTIS for $9.50.

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ENERGY RESEARCH ABSTRACTS

01 COAL AND COAL PRODUCTS

33493 (DOE/PETC/QTR—85/4) Pittsburgh Energy Technology Center quarterly technical progress report for the period ending September 30, 1985. (USDOE Pittsburgh Energy Technology Center, PA). Jun 1986. 165p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE86010843.

Encouraging progress was made toward the development of acid rain control technology. PETC competitively selected and awarded contracts totaling over $8 million over the next three years to firms proposing new concepts for reducing the costs of cleaning the flue gas emissions of older, coal-burning power plants. PETC and ANL have undertaken a joint venture in dry flue-gas scrubbing that will ultimately lead to testing of a sorbent for combined SO/sub x/ and NO/sub x/ removal in Argonne's 20-megawatt spray dryer. The overall objective of a high-sulfur coal research program is to conduct a broad spectrum of coal-related research in order to increase and expand the use of coal in an environmentally acceptable manner. In the liquefaction program area, operations with Wyodak subbituminous coal are proceeding smoothly (Run 249) at the Wilsonville Process Development Unit. Understanding the processes involved in catalyst deactivation is important to the development of longer lived catalysts. In the area of process analysis, PETC has acquired a new version of ASPEN (Advanced System for Process Engineeering) software. The new version was recently installed on PETC's VAX/VMS operating system and is the most up-to-date version currently available. Work at PETC has resulted in the development and testing of a highly automated capillary tube viscometer for use with heavy coal-derived liquids. Results of PETC research in Fischer-Tropsch product characterization were also shared with the technical community. A particularly difficult analytical problem in the characterization of Fischer-Tropsch products is quantitative determination of carbon number distributions by compound class. PETC scientists developed a method that uses capillary gas chromatographic techniques to make these determinations. A paper describing the method was the lead article in the July 1985 issue of the Journal of Chromatographic Science and was featured on the cover.

0104 Processing

REFER ALSO TO CITATION(S) 33561, 33563, 33566, 33567, 33636, 33644, 33650, 33655, 33656, 33735, 33737

33494 (CONF-800602—, pp 523-530) **Infrared analysis of coal gasifier product gases.** Holland, R.F.; Quigley, G.P.; Vasquez, M. (Los Alamos Scientific Lab., NM). 1980. NTIS.

From Symposium on instrumentation and control for fossil energy processes; Virginia Beach, VA, USA (9 Jun 1980).

Fourier transform infrared (FTIR) spectrometry conveniently measures the concentration of certain infrared-absorbing gases found in the product-gas stream of coal gasifiers. Using this technique, LASL performed preliminary measurements of gas mixtures representative of gasifier products in high-pressure, statically filled cells. Currently, two problems associated with the FTIR-spectrometry method preclude simulation of an actual coal-gasifier environment: (1) particulate loading would probably significantly decrease the optical throughput and thus the signal/noise ratio and (2) at high pressures, the path lengths through the absorbing media will likely be short, possibly causing the detector to intrude on the flow.

33495 (CONF-860508—2) Method to enhance the microbial liquefaction of lignite coals. Strandberg, G.W.; Lewis, S.N. (Oak Ridge National Lab., TN (USA)). 1986. Contract AC05-84OR21400. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011062.

From 8. symposium on biotechnology for fuels and chemicals; Gatlinburg, TN, USA (13 May 1986).

There is considerable interest in the potential use of microorganisms to liquefy low-ranked coals. Although a variety of fungal species are able to form liquid products from several types of lignite coals, only one naturally occurring lignite yet tested (a North Dakota lignite) has shown consistent susceptibility to rapid and extensive liquefaction. We have described a relatively simple method to enhance the susceptibility of more recalcitrant lignites and subbituminous coals to fungal liquefaction. 7 refs., 5 tabs.

33496 (DOE/ET/10205—T1-Vol.2) Fixed-bed gasification research using US coals. Volume 2. Gasification of Jetson bituminous coal. Thimsen, D.; Maurer, R.E.; Pooler, A.R.; Pui, D.; Liu, B.; Kittelson, D. (Black, Sivalls and Bryson, Inc., Houston, TX (USA). BS and B Energy Systems). 31 Mar 1985. Contract AI21-77ET10205. 220p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE86010833.

A single-staged, fixed-bed Wellman-Galusha gasifier coupled with a hot, raw gas combustion system and scrubber has been used to gasify numerous coals from throughout the United States. The gasification test program is organized as a cooperative effort by private industrial participants and governmental agencies. The consortium of participants is organized under the Mining and Industrial Fuel Gas (MIFGa) Group. This report describes the gasification testing of Jetson bituminous coal. This Western Kentucky coal was gasified during an initial 8-day and subsequent 5-day period. Material flows and compositions are reported along with material and energy balances. Operational experience is also described. 4 refs., 24 figs., 17 tabs.

33497 (DOE/ET/10205—T1-Vol.3) Fixed-bed gasification research using US coals. Volume 3. Gasification of Rosebud sub-bituminous coal. Thimsen, D.; Maurer, R.E.; Pooler, A.R.; Pui, D.; Liu, B.; Kittelson, D. (Black, Sivalls and Bryson, Inc., Houston, TX (USA). BS and B Energy Systems). 31 Mar 1985. Contract AI21-77ET10205. 301p. NTIS, PC A14/MF A01; 1; GPO Dep. File Number DE86010832.

A single-staged, fixed-bed Wellman-Galusha gasifier coupled with a hot, raw gas combustion system and scrubber has been used to gasify numerous coals from throughout the United States. The gasification test program is organized as a cooperative effort by private industrial participants and governmental agencies. The consortium of participants is organized under the Mining and Industrial Fuel Gas (MIFGa) Group. This report is the third volume in a series of documents prepared by Black, Sivalls and Bryson, Incorporated and describes the gasification of Rosebud subbituminous coal during the time period November 2-20, 1982. Test results and data are presented for the gasification of the coal and the operation of a slipstream tar scrubber to cool the gas and remove condensed tar. 5 refs., 29 figs., 18 tabs.

33498 **(DOE/ET/10205—T1-Vol.4) Fixed-bed gasification research using US coals. Volume 4. Gasification of Leucite Hills subbituminous coal.** Thimsen, D.; Maurer, R.E.; Pooler, A.R.; Pui, D.; Liu, B.; Kittelson, D. (Black, Sivalls and Bryson, Inc., Houston, TX (USA). BS and B Energy Systems). 31 Mar 1985. Contract AI21-77ET10205. 258p. NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE86010831.

A single-staged, fixed-bed Wellman-Galusha gasifier coupled with a hot, raw gas combustion system and scrubber has been used to gasify numerous coals from throughout the United States. The gasification test program is organized as a cooperative effort by private industrial participants and governmental agencies. The consortium of participants is organized under the Mining and Industrial Fuel Gas (MIFGa) Group. This report is the fourth volume in a series of reports describing the atmospheric pressure, fixed-bed gasification of US coals. This specific report describes the gasification of Leucite Hills subbituminous coal from Sweetwater County, Wyoming. The period of the gasification test was April 11-30, 1983. 4 refs., 23 figs., 27 tabs.

33499 **(DOE/ET/10205—T1-Vol.5) Fixed-bed gasification research using US coals. Volume 5. Gasification of Stahlman Stoker bituminous coal.** Thimsen, D.; Maurer, R.E.; Pooler, A.R.; Pui, D.; Liu, B.; Kittelson, D. (Black, Sivalls and Bryson, Inc., Houston, TX (USA). BS and B Energy Systems). 31 Mar 1985. Contract AI21-77ET10205. 104p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE86010830.

A single-staged, fixed-bed Wellman-Galusha gasifier coupled with a hot, raw gas combustion system and scrubber has been used to gasify numerous coals from throughout the United States. The gasification test program is organized as a cooperative effort by private industrial participants and governmental agencies. The consortium of participants is organized under the Mining and Industrial Fuel Gas (MIFGa) Group. This report is the fifth volume in a series of reports describing the atmospheric pressure, fixed-bed gasification of US coals. This specific report describes the gasification of Stahlman Stoker bituminous coal from Clarion County, PA. The period of the gasification test was April 30 to May 4, 1983. 4 refs., 16 figs., 10 tabs.

33500 **(DOE/ET/10205—T1-Vol.6) Fixed-bed gasification research using US coals. Volume 6. Gasification of delayed petroleum coke.** Thimsen, D.; Maurer, R.E.; Pooler, A.R.; Pui, D.; Liu, B.; Kittelson, D. (Black, Sivalls and Bryson, Inc., Houston, TX (USA). BS and B Energy Systems). May 1985. Contract AI21-77ET10205. 202p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE86010829.

A single-staged, fixed-bed Wellman-Galusha gasifier coupled with a hot, raw gas combustion system and scrubber has been used to gasify numerous coals from throughout the United States. The gasification test program is organized as a cooperative effort by private industrial participants and governmental agencies. The consortium of participants is organized under the Mining and Industrial Fuel Gas (MIFGa) Group. This report is the sixth volume in a series of reports describing the atmospheric pressure, fixed-bed gasification of US coals. This specific report describes the gasification of delayed petroleum coke from Pine Bend, MN. The period of the gasification test was June 1-17, 1983. 2 refs., 15 figs., 22 tabs.

33501 **(DOE/ET/10205—T1-Vol.7) Fixed-bed gasification research using US coals. Volume 7. Gasification of Piney Tipple bituminous coal.** Thimsen, D.; Maurer, R.E.; Pooler, A.R.; Pui, D.; Liu, B.; Kittelson, D. (Black, Sivalls and Bryson, Inc., Houston, TX (USA). BS and B Energy Systems). May 1985. Contract AI21-77ET10205. 154p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE86010828.

A single-staged, fixed-bed Wellman-Galusha gasifier coupled with a hot, raw gas combustion system and scrubber has been used to gasify numerous coals from throughout the United States. The gasification test program is organized as a cooperative effort by private industrial participants and governmental agencies. The consortium of participants is organized under the Mining and Industrial Fuel Gas (MIFGa) Group. This report is the seventh volume in a series of reports describing the atmospheric pressure, fixed-bed gasification of US coals. This specific report describes the gasification of Piney Tipple bituminous coal. The period of the gasification test was July 18-24, 1983. 6 refs., 20 figs., 17 tabs.

33502 **(DOE/ET/10205—T1-Vol.8) Fixed-bed gasification research using US coals. Volume 8. Gasification of River King Illinois No. 6 bituminous coal.** Thimsen, D.; Maurer, R.E.; Pooler, A.R.; Pui, D.; Liu, B.; Kittelson, D. (Black, Sivalls and Bryson, Inc., Houston, TX (USA). BS and B Energy Systems). May 1985. Contract AI21-77ET10205. 272p. NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE86010827.

A single-staged, fixed-bed Wellman-Galusha gasifier coupled with a hot, raw gas combustion system and scrubber has been used to gasify numerous coals from throughout the United States. The gasification test program is organized as a cooperative effort by private industrial participants and governmental agencies. The consortium of participants is organized under the Mining and Industrial Fuel Gas (MIFGa) Group. This report is the eighth volume in a series of reports describing the atmospheric pressure, fixed-bed gasification of US coals. This specific report describes the gasification of River King Illinois No. 6 bituminous coal. The period of gasification test was July 28 to August 19, 1983. 6 refs., 23 figs., 25 tabs.

33503 **(DOE/ET/10205—T1-Vol.9) Fixed-bed gasification research using US coals. Volume 9. Gasification of Elkhorn bituminous coal.** Thimsen, D.; Maurer, R.E.; Pooler, A.R.; Pui, D.; Liu, B.; Kittelson, D. (Black, Sivalls and Bryson, Inc., Houston, TX (USA). BS and B Energy Systems). May 1985. Contract AI21-77ET10205. 450p. NTIS, PC A19/MF A01; 1; GPO Dep. File Number DE86010826.

A single-staged, fixed-bed Wellman-Galusha gasifier coupled with a hot, raw gas combustion system and scrubber has been used to gasify numerous coals from throughout the United States. The gasification test program is organized as a cooperative effort by private industrial participants and governmental agencies. The consortium of participants is organized under the Mining and Industrial Fuel Gas (MIFGa) group. This report is the ninth volume in a series of reports describing the atmospheric pressure, fixed-bed gasification of US coals. This specific report describes the gasification of Elkhorn bituminous coal. The period of gasificastion test was September 13 to October 12, 1983. 9 refs., 24 figs., 35 tabs.

33504 **(DOE/ET/10205—T1-Vol.10) Fixed-bed gasification research using US coals. Volume 10. Gasification of Benton lignite.** Thimsen, D.; Maurer, R.E.; Pooler, A.R.; Pui, D.; Liu, B.; Kittelson, D. (Black, Sivalls and Bryson, Inc., Houston, TX (USA). BS and B Energy Systems). May 1985. Contract AI21-77ET10205. 186p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE86010825.

A single-staged, fixed-bed Wellman-Galusha gasifier coupled with a hot, raw gas combustion system and scrubber has been used to gasify numerous coals from throughout the United States. The gasification test program is organized as a cooperative effort by private industrial participants and governmental agencies. The consortium of participants is organized under the Mining and Industrial Fuel Gas (MIFGa) Group. This report is the tenth volume in a series of reports describing the atmospheric pressure, fixed-bed gasification of US coals. This specific report describes the gasification of Benton lignite. The period of gasification test was November 1-8, 1983. 16 refs., 22 figs., 19 tabs.

33505 **(DOE/ET/10205—T1-Vol.11) Fixed-bed gasification research using US coals. Volume 11. Gasification of Minnesota peat.** Thimsen, D.; Maurer, R.E.; Pooler, A.R.; Pui, D.; Liu, B.; Kittelson, D. (Black, Sivalls and Bryson, Inc., Houston, TX (USA). BS and B Energy Systems). May 1985. Contract AI21-77ET10205. 193p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE86010824.

A single-staged, fixed-bed Wellman-Galusha gasifier coupled with a hot, raw gas combustion system and scrubber has been used to gasify numerous coals from throughout the United States. The gasification test program is organized as a coooperative effort by private industrial participants and governmental agencies. The consortium of participants is organized under the Mining and Industrial

Fuel Gas (MIFGa) Group. This report is the eleventh volume in a series of reports describing the atmospheric pressure, fixed-bed gasification of US coals. This specific report describes the gasification of peat pellets and peat sods during 3 different test periods. 2 refs., 20 figs., 13 tabs.

33506 **(DOE/ET/10205—T1-Vol.12) Fixed-bed gasification research using US coals. Volume 12. Gasification of Absaloka/Robinson subbituminous coal.** Thimsen, D.; Maurer, R.E.; Pooler, A.R.; Pui, D.; Liu, B.; Kittelson, D. (Black, Sivalls and Bryson, Inc., Houston, TX (USA). BS and B Energy Systems). May 1985. Contract AI21-77ET10205. 222p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE86010823.

A single-staged, fixed-bed Wellman-Galusha gasifier coupled with a hot, raw gas combustion system and scrubber has been used to gasify numerous coals from throughout the United States. The gasification test program is organized as a cooperative effort by private industrial particpants and governmental agencies. The consortium of participants is organized under the Mining and Industrial Fuel Gas (MIFGa) Group. This report is the twelfth volume in a series of reports describing the atmospheric pressure, fixed-bed gasification of US coals. this specific reports describes the gasification of Absaloka/Robinson subbituminous coal. This volume covers the test period June 18, 1984 to June 30, 1984. 4 refs., 20 figs., 18 tabs.

33507 **(DOE/ET/10205—T1-Vol.13) Fixed-bed gasification research using US coals. Volume 13. Gasification of Blind Canyon bituminous coal.** Thimsen, D.; Maurer, R.E.; Pooler, A.R.; Pui, D.; Liu, B.; Kittelson, D. (Black, Sivalls and Bryson, Inc., Houston, TX (USA). BS and B Energy Systems). May 1985. Contract AI21-77ET10205. 258p. NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE86010822.

A single-staged, fixed-bed Wellman-Galusha gasifier coupled with a hot, raw gas combustion system and scrubber has been used to gasify numerous coals from throughout the United States. The gasification test program is organized as a cooperative effort by private industrial participants and governmental agencies. The consortium of participants is organized under the Mining and Industrial Fuel Gas (MIFGa) Group. This report is the thirteenth volume in a series of reports describing the atmospheric pressure, fixed-bed gasification of US coals. This specific report describes the gasification of Blind Canyon bituminous coal, from July 31, 1984 to August 11, 1984. 6 refs., 22 figs., 20 tabs.

33508 **(DOE/ET/10205—T1-Vol.14) Fixed-bed gasification research using US coals. Volume 14. Gasification of Kemmerer subbituminous coal.** Thimsen, D.; Maurer, R.E.; Pooler, A.R.; Pui, D.; Liu, B.; Kittelson, D. (Black, Sivalls and Bryson, Inc., Houston, TX (USA)). May 1985. Contract AI21-77ET10205. 136p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE86010821.

A single-staged, fixed-bed Wellman-Galusha gasifier coupled with a hot, raw gas combustion system and scrubber has been used to gasify numerous coals from throughout the United States. The gasification test program is organized as a cooperative effort by private industrial participants and governmental agencies. The consortium of participants is organized under the Mining and Industrial Fuel Gas (MIFGa) group. This report is the fourteen volume in a series of reports describing the atmospheric pressure, fixed-bed gasification of US coals. This specific report describes the gasification of Kemmerer subbituminous coal, from August 11, 1984 to August 15, 1984. 4 refs., 20 figs., 13 tabs.

33509 **(DOE/ET/10205—T1-Vol.15) Fixed-bed gasification research using US coals. Volume 15. Gasification of "fresh" Rosebud subbituminous coal.** Thimsen, D.; Maurer, R.E.; Pooler, A.R.; Pui, D.; Liu, B.; Kittelson, D. (Black, Sivalls and Bryson, Inc., Houston, TX (USA). BS and B Energy Systems). Sep 1985. Contract AI21-77ET10205. 147p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE86010820.

A single-staged, fixed-bed Wellman-Galusha gasifier coupled with a hot, raw gas combustion system and scrubber has been used to gasify numerous coals from throughout the United States. The gasification test program is organized as a cooperative effort by private industrial participants and government agencies. The consortium of participants is organized under the Mining and Industrial Fuel Gas (MIFGa) group. This report is the fifteenth volume in a series of reports describing the atmospheric pressure, fixed-bed gasification of US coals. This specific report describes the gasification of Rosebud subbituminous coal, from June 17, 1985 to June 24, 1985. 4 refs., 20 figs., 15 tabs.

33510 **(DOE/ET/10205—T1-Vol.16) Fixed-bed gasification research using US coals. Volume 16. Gasification of 2-inch Minnesota peat sods.** Thimsen, D.; Maurer, R.E.; Pooler, A.R.; Pui, D.; Liu, B.; Kittelson, D. (Black, Sivalls and Bryson, Inc., Houston, TX (USA). BS and B Energy Systems). Oct 1985. Contract AI21-77ET10205. 143p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE86010819.

A single, fixed-bed Wellman-Galusha gasifier coupled with a hot, raw gas combustion system and scubber used to gasify numerous coals from throughout the United States. The gasification test program is organized as a cooperative effort by private industrial participants and government agencies. The consortium of participants is organized under the Mining and Industrial Fuel Gas (MIFGa) group. This report is the sixteenth volume in a series of reports describing the atmospheric pressure, fixed-bed gasification of US coals. This specific test report describes the gasification of two-inch Minnesota peat sods, which began on June 24, 1985 and was completed on June 27, 1985. 4 refs., 18 figs., 14 tabs.

33511 **(DOE/ET/10205—T1-Vol.17) Fixed-bed gasification research using US coals. Volume 17. Gasification and liquids recovery of four US coals.** Thimsen, D.; Maurer, R.E.; Pooler, A.R.; Pui, D.; Liu, B.; Kittelson, D. (Black, Sivalls and Bryson, Inc., Houston, TX (USA). BS and B Energy Systems). Dec 1985. Contract AI21-77ET10205. 226p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE86010818.

A single-staged, fixed-bed Wellman-Galusha gasifier coupled with a hot, raw gas combustion system and scrubber has been used to gasify numerous coals from throughout the United States. The gasification test program is organized as a cooperative effort by private industrial participants and government agencies. The consortium of participants is organized under the Mining and Industrial Fuel Gas (MIFGa) group. This report is the seventeenth in a series of reports describing the atmospheric pressure, fixed-bed gasification of US coals. This report describes the gasification and pyrolysis liquids recovery test for four different coals: Illinois No. 6, SUFCO, Indianhead lignite, and Hiawatha. This test series spanned from July 15, 1985, through July 28, 1985. 4 refs., 16 figs., 19 tabs.

33512 **(DOE/ET/10205—T1-Vol.18) Fixed-bed gasification research using US coals. Volume 18. Program data summary and correlations.** Thimsen, D.; Maurer, R.E.; Lannto, O.; Pui, D.; Yeh, R. (Black, Sivalls and Bryson, Inc., Houston, TX (USA). BS and B Energy Systems). Dec 1985. Contract AI21-77ET10205. 94p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86010817.

A single-staged, fixed-bed, Wellman-Galusha gasifier coupled with a hot, raw gas combustion system and scrubber has been used to gasify numerous coals from throughout the United States. The gasification test program is organized as a cooperative effort by private industrial participants and government agencies. The consortium of participants is organized under the Mining and Industrial Fuel Gas Group (MIFGa). This report is the eighteenth volume in a series of reports describing the atmospheric pressure, fixed-bed gasification of US coals. This specific report summarizes the results of eighteen different gasification tests in which fourteen different fuels were gasified from August 1982 to August 1985. The summaries and analyses reported here include correlations of product yields and compositions with coal analyses and gasifier operating conditions. Also included here are discussions of limitations to throughput, transient response of the gasifier, the grate performance model, and a discussion of electrostatic precipitation in coal gas medium. 25 refs., 41 figs., 6 tabs.

33513 **(DOE/ET/10205—T1-Vol.19) Fixed-bed gasification research using US coals. Volume 19. Executive summary.** Thimsen, D.; Maurer, R.E.; Liu, B.Y.H.; Pui, D.; Kittelson, D. (Black, Sivalls and Bryson, Inc., Houston, TX (USA)). Dec 1985. Contract AI21-77ET10205. 50p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86010816.

A single-staged, fixed-bed, Wellman-Galusha gasifier coupled with a hot, raw gas combustion system and scrubber has been used to gasify numerous coals from throughout the United States. The gasification test program is organized as a cooperative effort under the Mining and Industrial Fuel Gas Group (MIFGA). This report is the nineteenth volume in a series of reports describing the atmospheric pressure, fixed-bed gasification of US coals. This volume briefly summarizes the results of eighteen different gasification tests in which fourteen different fuels were gasified from May 1982 to August 1985. The design gasification performance of all coals evaluated are summarized. In addition, summary design and economic data for industrial coal gasification systems are presented. 28 refs., 2 figs., 22 tabs.

33514 **(DOE/ET/10532—T28) Processing of Wyodak and Illinois ITSL oils: experimental studies. Refining and upgrading of synfuels from coal and oil shales by advanced catalytic processes. Twelfth interim report.** Sullivan, R.F. (Chevron Research Co., Richmond, CA (USA)). Nov 1985. Contract AC22-76ET10532. 97p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86008696.

Syncrudes produced from Wyodak and Illinois No. 6 Coals in the Integrated Two-Stage Liquefaction (ITSL) process were upgraded in pilot plant tests by hydrotreating with Chevron's commercial ICR 106 catalyst. Syncrudes with end points ranging from 725°F to 900°F were studied. In this end point range, relatively small increases in end point made the oils much harder to upgrade. In all cases, however, we found commercially feasible conditions to remove virtually all of the heteroatom impurities. At a given feed end point, processing severities required for Illinois and Wyodak oils were about the same. In this report, we compare properties of the Illinois and Wyodak ITSL oils and their products. The high density jet fuel and diesel products are of particular interest, because of their high volumetric energy contents. 9 refs., 22 figs., 30 tabs.

33515 **(DOE/ET/10532—T31) Refining and upgrading of synfuels from coal and oil shales by advanced catalytic processes. Quarterly report, January-March 1986.** Sullivan, R.F. (Chevron Research Co., Richmond, CA (USA)). Apr 1986. Contract AC22-76ET10532. 50p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86010686.

This report gives results from pilot plant tests in which two Catalytic Two-stage Liquefaction (CTSL) syncrudes - CTSL Light Oil and CTSL Light/Heavy Blend - were hydrotreated over Chevron's commercial ICR catalyst. Tests were made at a variety of conditions for direct comparison to results with other coal oils. Because of its high hydrogen content (12.6 wt %), low hereroatom content (0.09% N, 0.14% S), and low end point (634°F) compared to most other coal oils we have studied, CTSL light oil was easier to hydrotreat than other coal oils. Jet and diesel products met specifications when the hydrogen partial pressure was 1400 psia and the LHSV was 1.5. (Most of the other coal oils would require pressures of about 2300 psia at 1.5 LHSV for comparable product.) Not surprisingly, the CTSL light/heavy oil blend was more difficult to hydrotreat than CTSL light oil. Still, it appears to be easier to process than other coal oils of comparable end point (858°F) that we have studied. Essentially all of the heteroatom contaminants were removed by high-severity hydrotreating (0.5 LHSV, 750°F and 2300 psia hydrogen partial pressure). Also, the jet fuel and diesel fuel products either met specifications or were close to meeting specifications. (Inspections are incomplete.) This report also gives preliminary results from a test in which hydrotreated heavy Integrated Two-Stage Liguefaction (ITSL) oils were further hydrogenated. This study showed that low temperature hydrogenation is very effective for converting high boiling aromatics to naphthenes after most of the heteroatoms have been removed in an initial hydrotreatment at higher temperature. Included in the appendix is a paper "Transportation fuels from direct liquefaction products" which has been processed separately for inclusion in the Energy Data Base. 24 tabs.

33516 (DOE/ET/10532—T31, pp 14, App. I) **Transportation fuels from direct-liquefaction products.** Sullivan, R.F. Apr 1986. NTIS, PC A03/MF A01. File Number DE86010686.

In Refining and upgrading of synfuels from coal and oil shales be advanced catalytic processes. Quarterly report for the period January-March 1986.

Coal liquids produced in the ITSL and CTSL processes with EPs from about 600°F to over 900°F were hydrotreated to make diesel and jet fuels, and naphthas suitable for catalytic reforming to gasoline. Specific conclusions are as follows: (1) Oils from two-stage processes were easier to upgrade than comparable boiling-range products from single-stage processes, due to lower nitrogen and oxygen contents. However, as with products from single-stage processes, relatively small increases in EPs made the oils much harder to upgrade. (2) Except for modest differences in paraffin contents, properties of finished products of given boiling ranges from both Wyodak and Illinois coals, and both one- and two-stage processes studied were fairly similar, and consisted mainly of cyclic hydrocarbons. (3) Product boiling ranges were different, depending upon the liquefaction process and the cut point used in that process. The single-stage processes made more naphtha than the two-stage processes at a given cut point; the two-stage processes made more middle distillate. The ITSL process made more middle distillate than the CTSL process. Diesel products from two-stage processes had higher cetane number at a given aromatic content than those from single-stage processes. (4) In all cases studied, the jet fuel and diesel products had high densities and, therefore, high volumetric-energy contents. (5) Wyodak CTSL light oil had a higher hydrogen content and lower heteroatom content than the othet oils. These factors, plus its low EP, made it easier to upgrade than the other syncrudes studied. (6) For high EP syncrudes, an attractive upgrading route is a two-step process - hydrotreating to remove most of the heteroatoms, followed by low-temperature hydrogenation to saturate aromatics. 9 refs., 6 tabs.

33517 **(DOE/ET/14928—12) Experimental evaluation of the steady state and dynamic performance characteristics of the interactive units of a coal gasification process.** (General Electric Co., Schenectady, NY (USA). Corporate Research and Development Center). Nov 1985. Contract AC21-80ET14928. 320p. (SRD—85-027). NTIS, PC A14/MF A01; 1; GPO Dep. File Number DE86004814.

Coal gasification/gas cleanup fuel plants for synthetic fuel applications must be developed within two sets of constraints: one imposed by dynamic load response to variations in end-use demand, the other by the need to comply with environmental regulations. The object of the program was to establish the technology base required to operate within these constraints. This base was formulated by characterizing system and component fuel plant performance in both steady-state and dynamic operation, and the information required to establish system control logic was developed. An integrated coal gasification system composed of process units which have previously undergone evaluation (i.e., a Process Evaluation Facility - PEF) at the contractor's site was used to perform tests for establishing an information base which would: establish performance parameters for each process unit; define dynamic interactions of process units operating under variable loads; characterize effluent flow streams from the process; and develop an experimentally verified simulation model for integrated system operations. The Process Evaluation Facility (PEF) system includes an advanced fixed-bed gasifier, a low-temperature gas cleanup system, and a gas turbine simulator; auxiliary facilities include a high-pressure air and steam supply system.

33518 **(DOE/FE/05121—2058) Design, construction and operation of a coal gasification process development unit. Final report.** (Mountain Fuel Resources, Inc., Salt Lake City, UT (USA)). Apr 1986. Contract AC21-81FE05121. 476p. NTIS, PC A21/MF A01; GPO Dep. File Number DE86010430.

A 30 tons per day high rate, dry feed, entrained coal gasification process development unit was designed, constructed and operated to demonstrate the scale-up ability from an existing one-half ton per day design and to provide data for further scale-up system components. The unit was operated for a total of 2177 hours, the

longest continuous operation being 129 hours. Controlled continuous dry-feeding of pulverized coal into the gasifier at pressures between 100 to 260 psia was achieved. A highly redundant and rapid response control and safety system was developed through extensive analytical studies and operational tests. Operational problems with equipment are described and discussed. Gasifier performance data were obtained with six different feedstocks, two Utah bituminous coals, an Eastern bituminous coal from Pittsburgh Seam, a Wyoming subbituminous coal, a North Dakota lignite, and a green petroleum coke. Reactor throughputs of up to 754 lbs/hr/ft^2 or 317 lbs/hr/ft^3, gas yields of 32 SCF/lb coal and gas heating values of 294 Btu/SCF were achieved. Data from steady state test periods with Utah coal from the SUFCO mine were correlated with a computer model. Preliminary design and economic studies were completed for three different sizes of scaled-up plants in which coal would be gasified and the gas used to synthesize methanol. Production costs were shown to be competitive with the cost of producing methanol from natural gas. A new sulfur-tolerant, combined shift and methanation catalyst developed by Haldor Topsoe was successfully tested for a total of 1080 hours with gas from the gasifier. 16 refs., 100 figs., 82 tabs.

33519 (DOE/FE/60177—0044, pp 3.1-3.31) **Underground coal gasification.** Nov 1985. NTIS, PC A07/MF A01. File Number DE86010951.

In Western Research Institute quarterly technical progress report, July-September 1985.

An abandonment plan for the Hanna underground coal gasification (UCG) test site is being developed to determine the steps required to permit DOE to abandon the site. The plan will include a thorough evaluation of current environmental conditions at the site and will present a prediction of contaminant transport over time. Strategies to remove contamination from the groundwater will be discussed. The plan will be used by DOE in formulating efforts to appease Wyoming regulatory agencies and gain permission to abandon the site. Efforts continued on developing techniques and procedures to improve the accuracy and reliability of contamination data at UCG test sites. Field sampling procedures were developed and documented to assure consistent and accurate groundwater sample extraction. During groundwater extraction, the sample stream will be continuously monitored for pH, temperature, and conductivity to assure the sample is representative of actual groundwater conditions. Work progressed on three mitigation processes for groundwater contaminants resulting from UCG operations. Temperature effects on phenol degradation through microbial metabolization were determined. The microbes, cultured from UCG process waters, were shown to be sensitive to temperature. Phenol degradation at 37°C was substantially more effective than 20°C. Coagulation-precipitation research also continued. This process removed from wastewaters the colloidal particulates which can foul contaminant removal process equipment. Reverse osmosis is now being tested to demineralize UCG contaminated waters. Of particular interest is the removal of sulfates (measured by conductivity) and total dissolved solids (TDS). Despite problems with membrane fouling, very good reductions of conductivity and TDS were obtained. 4 refs., 5 figs., 7 tabs.

33520 (DOE/MC/19392—1721) **Analysis of options for management of spent Stretford solution.** Tallon, J.T.; Rittmeyer, R.W.; Maruhnich, E.D. (Environmental Research and Technology, Inc., Pittsburgh, PA (USA)). Jun 1984. Contract AC21-82MC19392. 103p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85008611.

During each cycle of the Stretford process a small percentage of the sulfide present in the feed gas is irreversibly converted to thiosulfate and sulfate, and cyanide is irreversibly convertd to thiocyanate. The accumulation of sulfates in the Stretford solution reduces the solubility of the active Stretford chemicals [i.e., sodium vanadate and anthraquinone-disulfonic acid (ADA)]. This decreases the rate of oxidative regeneration. To maintain the thiosulfate, sulfate and thiocyanate concentrations at acceptable levels, a continuous purge, or blowdown, of the Stretford solution is required. The continuous purge of Stretford solution results in a loss of active chemicals which must be replaced and ultimately increases Stretford operating costs. In addition, the blowdown must be reclaimed, treated, and/or disposed which also adds to the operating costs. This report presents an analysis of waste-management alternatives for handling the blowdown stream produced from the Stretford process. The objective of this study is to evaluate the relative economics of the most promising alternatives available for managing spent Stretford solution by comparing technical feasibility, performance, and costs associated with the alternatives. The available Stretford solution-characterization data and waste-management options were identified by reviewing literature sources. The waste-management options identified were then screened based on technical, economic and environmental criteria to identify the most promising set of alternatives. Finally, a comparative economic analysis was performed on the most promising set of alternatives using the Stretford process at the Great Plains Gasification Associates (GPGA) facilty as the basis for comparison. 23 refs., 5 figs., 29 tabs.

33521 (DOE/MC/21046—1949) **Characterization of raw product gas from a low-temperature lignite test at the KRW coal gasification process development unit.** Skinner, F.D. (Radian Corp., Austin, TX (USA)). Dec 1985. Contract AC21-84MC21046. 25p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86004634.

Based on the data obtained as a result of this study, the following conclusions were drawn: (1) When comparing the production rate of volatile nitrogen species (NH_3, HCN) between the two operating temperatures of the lignite test, no correlation with gasifier temperature was seen. It should be noted that other operating conditions besides temperature were different for the two lignite set points, including coal feed rate, O_2/coal, steam/coal, and recycle gas/coal ratios. (2) The production rate of ammonia did not appear to be solely a function of coal nitrogen content. (3) The NH_3/HCN ratio varied among the runs; it was lowest for the bituminous coal test run. There was no correlation between the ratio of reduced nitrogen species in the raw gas and gasifier temperature. (4) There was evidence of a correlation between higher benzene production per mass of coal and lower gasifier temperature. (5) For the volatile organics (detected by desorbing from Tenax resin traps), there was no observed correlation between concentration and gasifier temperature. The levels of organics were very low for all of the runs. It is recommended that correlations be developed describing the distribution of pollutant species (e.g., nitrogen and sulfur species, organics, and trace elements) around the KRW gasifier as a function of operating variables. The data base for the development of such correlations would include the data presented in this report together with additional publically available data from other test runs at the KRW PDU. 2 refs., 1 fig., 6 tabs.

33522 (DOE/MC/21225—16) **Wet carbonization of lump-size low-rank coals by a Novel Non-Slurry Approach. Progress report, May-July 1985.** Lau, F.S.; Roberts, M.J.; Jerger, D.E.; Mensinger, M.C.; Rue, D.M. (Institute of Gas Technology, Chicago, IL (USA)). Oct 1985. Contract AC21-84MC21225. 55p. NTIS, PC A04/MF A01; GPO Dep. File Number DE86003764.

Work continued this quarter on the design and procurement of equipment to construct the wet-carbonization process research unit(PRU). The PRU is being designed to process about 100 lb/h of as-received coal. Nine batch wet-carbonization tests were conducted this quarter. Tests have now been conducted with all four coals specified in the approved test plan. The four coals are lignites from the Indianhead and Center mines, North Dakota, subbituminous coal from the Rosebud mine, Montana, and lignite from the South Hallsville mine near Martin Lake, Texas. The operating conditions for the tests were temperatures, pressures, and residence times in the range of 400° to 650°F, 250 to 3300 psia, and 0 to 60 minutes, respectively. Results to date show that overall component conversions for the two North Dakota lignites are similar for the tests conducted at comparable conditions. The Texas lignite is less reactive and the Montana Rosebud subbituminous coal to significantly less reactive than the North Dakota lignites. Handling characterization tests were conducted with raw and wet-carbonized coals. These tests include drop-shatter tests, bulk and particle density measurements, and particle shrinkage determinations. Particle-size reduction due to drop-shatter testing of wet-carbonized coal was greater than that of the corresponding feed coal and increased with wet-carbonization severity. However, once air-dried, the raw coal decrepitated (crumbled) much more readily than the air-dried wet-carbonized coal. Bulk and particle densities of the wet-carbonized

coal products decreased with increasing temperature and residence time. Anaerobic biogasification potential assays were continued this quarter to determine the biodegradability of liquid product samples from the batch wet-carbonization tests. 16 figs., 8 tabs.

33523 **(DOE/MC/21225—2035) Wet carbonization of lump-size low-rank coals by a novel non-slurry approach. Progress report, November 1985-January 1986.** Lau, F.S.; Roberts, M.J.; Srivastava, V.J.; Mensinger, M.C.; Janulis, J.A.; Rue, D.M.; Henry, M.P. (Institute of Gas Technology, Chicago, IL (USA)). Mar 1986. Contract AC21-84MC21225. 32p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86001082.

This report presents the work performed by the Institute of Gas Technology (IGT) from November 1, 1985 through January 31, 1986, under DOE Contract No. DE-AC21-84MC21225 for the project, "Wet Carbonization of Lump-Size Low-Rank Coals by a Novel Non-slurry Approach." Construction of the 100 lb/h Process Research Unit (PRU) was completed during the quarter. However, the high pressure boiler was not yet ready for operation, because several parts on the level control unit and a boiler operators manual were not received from the boiler manufacturer. Procurement and installation of the missing items will be completed by IGT to minimize further delays in the startup of the PRU. Shakedown testing of the PRU equipment and instrumentation continued during the quarter. One batch wet-carbonization test was conducted this quarter with North Dakota Indianhead lignite and water with sodium hydroxide. The objective of this test was to determine the effect of this additive on the wet-carbonization characteristics. The results of this test will be presented when the analyses of the test samples have been completed. It was determined in a test conducted during the previous quarter that sulfuric acid (as an additive) did not have any significant effect on wet carbonization. During this quarter the Free-Fall Reactor was readied for devolatilization tests with the raw and wet-carbonized coals. A batch aerobic reactor was assembled during this quarter. The objective of the aerobic tests is to determine the feasibility of pretreating the product water with aerobic cultures to make it more amenable to anaerobic treatment and methane generation. Two inocula were prepared for these tests. 8 figs., 3 tabs.

33524 **(DOE/MC/22064—T1) Injection of densely loaded flows into entrained-flow gasifiers. First quarterly progress report, October 1-December 31, 1985.** Rizk, M.A.; Edelman, R.B. (Science Applications International Corp., Chatsworth, CA (USA)). Jan 1986. Contract AC21-85MC22064. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86006897.

The overall objective of this project is to develop improved understanding of the injection and mixing of densely loaded gas/solid mixtures into gas streams. The ultimate application of the results will be the development of improved injection and mixing configurations for entrained-flow coal gasifiers. In entrained-flow gasification, the injection and dispersion of heavily loaded mixtures of coal and gases is an important factor for overall reactor performance and the uniformity of coal processing. Poor disperison in a reactor has several adverse consequences. These include depressed particle heating rates, which affect critical devolatilization phenomena. Limited mixing also leads to increased reactor residence time requirements and nonuniformity of coal treatment. Information is needed to provide guidance for establishing reactor inlet configurations which will accelerate mixing and to facilitate modeling of such reactors. Data are available for systems which are more dilute than those used for entrained gasifiers, but special considerations lead to the desirability of using a minimum amount of injection flow in a gasifier. 54 refs.

33525 **(DOE/PC/40803—8) Characterization of tar products from rapid pyrolysis of bituminous coals and development of a physically realistic model of softening coal pyrolysis. Final report.** Suuberg, E.; Unger, P.; Sezen, Y.; Lilly, W. (Brown Univ., Providence, RI (USA). Div. of Engineering). Dec 1985. Contract FG22-81PC40803. 620p. NTIS, PC A99/MF A01; 1; GPO Dep. File Number DE86005738.

This report summarizes the progress made on the two primary objectives of this research: collection of time and temperature resolved chemical information on tars evolved during the rapid pyrolysis of coals; and use of the information of Item 1 to evaluate and further develop a combined mass transfer-chemical reaction model of coal pyrolysis. Data have been collected on the tars evolved from three pulverized (50 to 100 um) bituminous coals and one lignite. These data include molecular weight distributions of the tars, and chemical compositions and infrared spectra of the tars as a function of molecular weight, time, and temperature (from 300 K to 1300 K). The conclusion is reached that escape of the tars from the particles is primarily an evaporation process, but that some role of entrainment is probable. Spectral evidence suggests that ether linkages are important in high molecular weight fractions, but not low. Otherwise, the tars are quite similar in all except the highest molecular weight fractions, suggesting that it might be appropriate to view them, to a first approximation, as depolymerization fragments consisting of similar repeat units. Time resolved compositional measurements of the tars and extractable materials remaining in chars suggest that a precursor formation in the char occurs on a time scale comparable to the evaporation time scale. Secondary repolymerization reactions are characterized by higher activation energies than are the initial tar formation reactions. Numerous experimental problems are encountered in trying to obtain reliable data on molecular weight distributions of coal tars. Recommended experimental techniques are presented. A new model of coal pyrolysis is presented, incorporating the findings of this study. Appendix 1 has been entered separately into EDB and ERA.

33526 (DOE/PC/40803—8, pp 181, Appendix I) **Pyrolysis behavior of a softening bituminous coal.** Unger, P.E. Dec 1985. NTIS, PC A99/MF A01. File Number DE86005738.

Thesis.

In Characterization of tar products from rapid pyrolysis of bituminous coals and development of a physically realistic model of softening coal pyrolysis. Final report.

This thesis involves a combined experimental and modeling study of the rapid pyrolysis behavior of bituminous coal. The emphasis is on the evolution of heavy tars and the role of mass transfer in shaping this process. Pyrolysis product distributions were determined at both vacuum (total helium pressure of 300 microns mercury) and atmospheric (helium pressure of 10 psig) conditions. Both the quantities of the observed products and the molecular weight distributions of tar species have been measured as functions of the temperature and pressure of the pyrolysis experiment. The tar molecular weight distribution data were found to exhibit trends grossly different from the trends predicted by the 'well mixed' coal pyrolysis model, and suggestive of the 'stagnant particle' model. For this reason, a model was developed in which the particle is assumed to be completely stagnant, and both internal and external diffusive mass transfer problems are included in the model. Under vacuum pyrolysis conditions, internal transport alone is likely to be controlling, while for higher pressures it may be a combination of both internal and external mass transfer that is responsible for the observed tar molecular weight distribution results. This observation is substantiated by the differences in tar molecular weight distributions between vacuum and atmospheric conditions. Were the mass transfer mechanism the same in both cases, the results should be identical. The fact that the tar molecular weight distributions are not identical for vacuum and atmospheric pyrolysis does suggest that there are differences in the mass transfer mechanisms. Hence it is postulated that external diffusion is becoming of importance at atmospheric conditions. Indeed, at high enough pressures, the 'well-mixed' model becomes valid, although the experimental apparatus used here precluded obtaining data at such conditions. 58 refs., 91 figs., 35 tabs.

33527 **(DOE/PC/50021—11-Vol.2) Advanced research program for expanded bed hydroprocessing of coal extract. Volume 2. Task 2 work in stirred autoclave reactors and single reactor LC-Finer operation, June 1, 1982-July 31, 1985.** Chillingworth, R.S.; Matyas, R.S.; Potts, J.D. (Cities Service Research and Development Co., Tulsa, OK (USA)). Jul 1985. Contract AC22-82PC50021. 231p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE86003570.

The catalytic upgrading of Short Contact Time (SCT) coal extract in bench-scale stirred autoclave reactors has been shown to

be an effective way of inexpensively simulating PDU LC-Finer units. Tests were carried out to determine the effect of temperature staging in single and series reactor configurations on product quality with respect to being a good hydrogen donor solvent. It was shown that two series reactors operating in the range of 740 to 770°F produced the most effective solvent for coal conversion under SCT conditions. A correlation was developed which related coal conversion with the solvent quality parameters of the solvent. Four different catalysts were run in the stirred autoclaves including an aged Shell 324M NiMo, a fresh Shell 324S NiMo, a Shell 324 low density NiMo, and a fresh Shell 454 NiW species. Although differences in operating conditions precluded direct comparisons, the NiW extrudate catalyst produced a poorer quality solvent than the NiMo catalysts. Additionally, runs performed in single reactor LC-Finer PDU's have been used to provide simulated interstage reactor samples for the ITSL LC-Finer PDU. The conversion of 850°F+ material and denitrification were found to require more than one reactor to achieve maximum levels. Hydrogenation, however, occurs largely in the first reactor, particularly with Illinois 6 coal extract when compared with Wyodak coal extract. A good quality recycle solvent for the SCT reaction is produced from the single reactor LC-Finer. 4 refs., 41 figs., 40 tabs.

33528 **(DOE/PC/50021—11-Vol.3) Advanced research program for expanded bed hydroprocessing of coal extract. Volume 3. Task 2 work in microautoclave reactors, June 1, 1982-July 31, 1985. Final technical report.** Matyas, R.S.; Potts, J.D. (Cities Service Research and Development Co., Tulsa, OK (USA)). Jul 1985. Contract AC22-82PC50021. 249p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE86003571.

An extensive array of Short Contact Time (SCT) experimental matrices were investigated in support of Integrated Two-Stage Liquefaction Process Development Unit (ITSL PDU) operations. Various matrices explored the operating parameters and pasting solvents required to maximize coal dissolution and conversion to liquids. The effects of added pyrite were also investigated. Several blends of Anti-solvent Deashing (ASDA) underflow as well as LC-Fining (LCF) feed were used to correspond with different PDU process configurations. Solvents from both Wyodak subbituminous and Illinois 6 bituminous coals were run to measure solvent quality for coal dissolution. These solvents were prepared from various ITSL process configurations and process parameters. In support of the SCT microautoclave experiments, extensive analytical data was statistically analyzed. Correlations based on LCF solvent properties were developed and will be useful in predicting the degree of coal dissolution. Pressure versus residence time effects were also explored in the microautoclave reactor system. Previous data from the ITSL data base were analyzed for the effect of low hydrogen pressure on coal dissolution. The spent catalysts from the three LCF reactors of the second stage of the ITSL PDU process were tested for hydrogenation activity as measured by naphthalene hydrogenation. The effects of the regeneration of whole spent catalysts and ground spent catalyst were explored. Several catalysts were investigated in a mode of accelerated deactivation. The value of presulfiding hydrogenation catalysts for upgrading coal extracts was also investigated. Two matrices were conducted to determine the thermal effects on coal extracts without a catalyst charge to the microautoclave reactor system. 81 figs., 18 tabs.

33529 **(DOE/PC/50030—T12) Fluid seals development for coal liquefaction slurry pumps. Final report, 28 September 1982-31 January 1986.** Burcham, R.E.; Keba, J.E. (Rockwell International Corp., Canoga Park, CA (USA). Rocketdyne Div.). Nov 1985. Contract AC22-82PC50030. 363p. NTIS, PC A16/MF A01; 4; GPO Dep. File Number DE86005475.

The results of a fluid seal developemnt program for coal liquefaction centrifugal and reciprocating slurry pumps are presented. The preliminary evaluation indicated that the best fluid seal concepts were the hydrostatic convergent tapered bore floating ring and the hydrostatic orifice compensated floating bushing. Detail evaluation and analysis were performed and the tapered bore floating ring seal was selected for final design and fabrication. The seal rings were constructed from solid tungsten carbide K68 with a convergent taper ratio of 2.0 and nominal diametral exit clearances of 0.002 to 0.003 inch. The laboratory testing demonstrated satisfactory leakage and negligible wear with synthetic slurry at typical field conditions. The centrifugal seals accumulated 72 hours with final leakage rates of 0.05 to 0.15 gpm. The reciprocating seals accumulated 63.3 hours with leadage rates of 0.04 to 0.05 gpm. The reciprocating seal field testing demonstrated successful field operation with actual process fluids. A total of 506 hours was daccumulated with no significant wear and leakage rates of 0.02 to 0.05 gpm. 32 refs., 143 figs., 32 tabs.

33530 **(DOE/PC/50041—63) Wilsonville Advanced Coal Liquefaction Research and Development Facility, Wilsonville, Alabama. Run 247 with Illinois No. 6 coal. Technical progress report.** (Catalytic, Inc., Wilsonville, AL (USA)). Feb 1986. Contract AC22-82PC50041. 177p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE86007813.

This report presents the operating results for Run 247 at the Advanced Coal Liquefaction R and D Facility in Wilsonville, Alabama. This run operated in a Two-Stage Liquefaction (TSL) mode using Illinois No. 6 bituminous coal from the Burning Star mine. The primary run objective was to obtain performance data for the TSL system and the individual process units with particular emphasis on hydrotreating catalyst performance. 266 tons of coal were fed in 2845 hours of operation. The run configuration was a Reconfigured Integrated Two-Stage Liquefaction (RITSL) mode. In RITSL, the products from the thermal (first stage) unit are sent to the hydrotreater (second stage) unit without prior deashing. The hydrotreated resid and ash are sent to the Critical Solvent Deashing Unit, and the deashed resid is then recycled to the thermal unit. Operating conditions were adjusted to obtain high coal conversions, acceptable deashing performance, and an "all-distillate" product slate. Nine operating periods were defined based on testing at different sets of operating conditions. Elementally-balanced yields were calculated for several days during each operating period. Averaged yields and operating conditions for these periods are presented throughout this report. For five of the operating periods, blends of the distillate products were prepared, and detailed product quality analyses were done for each boiling point cut. A special radioactive tracer study was also conducted to assess the level of mixing in the TLU dissolver. 16 refs., 38 figs., 37 tabs.

33531 **(DOE/PC/50041—66) Wilsonville Advanced Coal Liquefaction Research and Development Facility, Wilsonville, Alabama. Development of VaSTeC autoclave technique and application to pilot plant guidance.** (Catalytic, Inc., Wilsonville, AL (USA)). Apr 1986. Contract AC22-82PC50041. 71p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86010746.

A precise technique for studying coal liquefaction in a 200 cc stirred-batch-autoclave has been developed. Reaction pressures of up to 4000 psig and temperatures of up to 850°F can be employed. The slurry temperature in the autoclave is controlled within 2°F by raising or lowering the autoclave which is partially submerged in a sandbath; hence the name: Variable Submergence Temperature Control (VaSTeC). Heatup and cooldown are achieved in 5 and 2 minutes, respectively. A mini-scale vacuum distillation procedure was developed for measurement of 1000°F-distillate with a repeatability of 0.3%. About 99% material balance is routinely obtained in the autoclave runs. The following yield repeatabilities have been demonstrated (MAF coal basis):H_2 cons. (0.1%), C_1 to C_3 gas (0.3%), C_4-1000°F distillate (2.4%), and unconverted carbon (0.5%). The autoclave can simulate the yield slate of the thermal liquefaction unit (TLU) of the Wilsonville pilot plant. Several reaction variables were studied with Illinois No. 6 bituminous and Wyodak subbituminous coals. Benefit of increased reaction time and decreased temperature on the yield slate was demonstrated. 12 refs., 4 figs., 23 tabs.

33532 **(DOE/PC/50793—T14) Combined processing of coal and heavy resids. Final report, July 1982-January 1986.** Curtis, C.W.; Guin, J.A.; Tarrer, A.R. (Auburn Univ., AL (USA). Coal Conversion Lab.). 1986. Contract FG22-82PC50793. 242p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE86010801.

The results from this report are summarized on Tables 47, 48 and 49. These results are presented in terms of the average values

obtained from the experiments performed and present a good overview of the results obtained. The addition of catalyst in the residuum upgrading reactions increased the amount of PS (pentane-solubles) production achieved and, in the case of $NiMo/Al_2O_3$, substantially increased the IOM formed. The presence of TET (tetralin) had varying effect; but only in the reaction with $NiMo/Al_2O_3$ did TET improve the PS production. In all upgrading reactions, the BS fraction was reduced during the reaction forming both lighter and heavier products. The catalytic reactions with $NiMo/Al_2O_3$ and Mo naphthenate at 425°C reduced the BS (benzene-soluble) fraction the most. The combination of TET plus $NiMo/Al_2O_3$ resulted in the greatest reduction of the BS fraction and subsequent increase in the PS fraction. In the coprocessing experiments, both the addition of catalyst and the addition of TET promoted coal conversion. Coal conversion in coprocessing appears to be dependent upon both catalyst and hydrogen donation except in the case of a highly active catalyst where catalytic activity predominates. TET did not promote the production of PS materials in either the thermal or catalytic reactions. The effect of TET and catalytic treatment on BS production is also instructive in examining the roles and relative importance of these two factors in coprocessing. Since all of these reactions showed positive oil production, the increases observed in the BS production were directly related to the upgrading of liquefied coal to BS products. Thus, the presence of TET assisted in the production of BS but not in the production of PS. The presence of a hydrotreating catalyst was required for PS production in the copressing reactions. Appendices A, B and C have been entered separately into EDB and ERA.

33533 (DOE/PC/50793—T14, pp 28, Appendix A) **Solvent modifications for coprocessing coal with petroleum residua.** Curtis, C.W.; Tsai, K.J.; Guin, J.A. 1986. NTIS, PC A11/MF A01. File Number DE86010801.

In Combined processing of coal and heavy resids. Final report, July 1982-January 1986.

Coprocessing of coal and petroleum solvents is examined under a variety of reaction conditions. The effects of solvent modification procedures on enhancing methylene chloride/methanol (MeCl/MeOH) soluble coal conversion and pentane soluble oil production are studied. Solvent modification procedures performed prior to coprocessing reactions include pentane deasphalting, catalytic hydrotreatment, H-donor addition, and blending of conversion were variously affected by the different solvent modifications. Prior hydrotreatment of petroleum solvents generally enhanced coal conversion, as did H-donor addition. The presence of a hydrotreating catalyst exerted a leveling effect on the effects of solvent modification. Blending of coal liquids and petroleum solvents resulted in complex and not readily predictable interactions. Solvents yielding the highest MeCl/MeOH soluble coal conversion were not generally the optimal solvents for pentane soluble oil production. 20 refs., 6 figs., 3 tabs.

33534 (DOE/PC/50793—T14, pp 25, Appendix B) **Coal solvolysis in heavy petroleum crudes and residua.** Curtis, C.W.; Gain, J.A.; Pass, M.C.; Tsai, K.J. 1986. NTIS, PC A11/MF A01. File Number DE86010801.

In Combined processing of coal and heavy resids. Final report, July 1982-January 1986.

This work investigates the solvolysis of coal in six different heavy petroleum crudes and residua. Coprocessing reactions are performed under three sets of constant reaction conditions, yielding informative comparative data for processing applications. Definitive comparisons of coal reactivity and solvolysis in the petroleum solvents have been obtained using sequential extraction which provides a measure of the degree of upgrading achieved by the liquefied coal. Regressive reactions and low coal conversions are observed in coprocessing reactions in N_2 at 400°C. Higher conversions and a reduction in regressive reactions are observed in H_2 at 400°C. Catalytic hydrotreatment and higher temperature, 425°C, results in increased coal conversion and a net production of pentane soluble materials. The effect of reactor loading and reaction temperature using different solvents and reaction conditions on the product slate is also examined. 18 refs., 8 tabs.

33535 (DOE/PC/50793—T14, pp 30, Appendix C) **Catalytic coprocessing: effect of catalyst type and sequencing.** Curtis, C.W.; Tsia, K.J.; Guin, J.A. 1986. NTIS, PC A11/MF A01. File Number DE86010801.

In Combined processing of coal and heavy resids. Final report, July 1982-January 1986.

The importance of catalyst accessibility, loading and type in coprocessing coal with heavy residua was evaluated by examining the changes in the product slate and the production of upgraded products. A commercial hydrotreating catalyst, $NiMo/Al_2O_3$; bulk metal sulfides, FeS_2 and MoS_2; a homogeneous catalyst, H_2S; and four oil-soluble metal salts of organic acids were used. The more accessible $NiMo/Al_2O_3$ powder promoted higher conversion and more upgrading than did the less accessible extrudates. The oil-soluble catalyst precursors showed higher levels of activity in the coprocessing reaction than did either $NiMo/Al_2O_3$ or pyrite. Catalyst sequencing by using an inexpensive pyrite catalyst in the first stage and a highly effective hydrotreating catalyst in the second stage offers several benefits to coprocessing since coal conversion can be attained in the first stage without fouling an expensive hydrotreating catalyst. The product slates from catalyst sequencing in two stages were examined and compared to the results obtained from single stage processing at comparable conditions. 23 refs., 3 figs., 7 tabs.

33536 (DOE/PC/50800—T14) **Transport and relaxation processes in supercritical fluids. Final technical report, October 1, 1982-March 31, 1986.** Jonas, J. (Illinois Univ., Urbana (USA). Dept. of Chemistry). 18 Mar 1986. Contract FG22-82PC50800. 56p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86007930.

The main goal of the research supported by this grant has been the advancement of our fundamental understanding of transport and relaxation behavior of compressed supercritical fluids and binary supercritical fluid systems. An important aspect of our work was the development of new experimental techniques for the atomic and molecular level investigations of supercritical fluids. In our NMR studies we developed a novel in-situ NMR method for the measurements of solubilities of solids in compressed supercritical fluids. This method also yields phase information on the system. The solubility of solid naphthalene in supercritical carbon dioxide was measured. The P-T trace of the S-L-G phase lines was also determined. In the area of transport in supercritical fluids we developed NMR instrumentation using fixed field gradient spin-echo technique to measure self-diffusion coefficients in supercritical fluids. The self-diffusion in supercritical ethylene and supercritical toluene was measured. In addition to the NMR method, we also developed and evaluated an FTIR technique to measure solubilities of solids in supercritical fluids. The system anthracene-carbon dioxide was investigated. Our preliminary lase Rayleigh and Raman experiments on collision induced scattering in supercritical fluids opened a new area of investigations of intermolecular interactions in supercritical fluids. The N_2O and CO_2 fluids were studied. 106 refs.

33537 (DOE/PC/50814—T10) **Catalysis mechanism of coal liquefaction by H_2S. Final report, September 21, 1982-March 31, 1986.** Stenberg, V.I. (North Dakota Univ., Grand Forks (USA). Dept. of Chemistry). 1986. Contract FG22-82PC50814. 34p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86010667.

More detailed data has been generated during the course of this contract to substantiate the modes in which hydrogen sulfide promotes liquefaction: (1) by hydrocracking; (2) hydrogen atom donation; (3) form aromatic sulfur bonds by pi-orbital attack; (4) catalyze the shift reaction; and (5) interaction with coal via an elemental sulfur intermediate. H_2S is now demonstrated to be catalytic with its quantitative recovery at the end of each reaction provided the reactor surface is presulfided. Low concentrations of H_2S of about 100 psi are optimum for coal conversion in an organic media. The metal reactor wall has been demonstrated to participate when H_2S is present. Hydrogen sulfide promotes the liquefaction of three ranks of coals: lignites, subbituminous and bituminous coals both in the absence and presence of a good hydrogen donor solvent. Therefore, it does more than merely act as a good hydrogen donor. The iron of the metal reactors was continually interfering with the

data. Consequently, it was necessary to develop this chemistry. The H_2S proved to be converting the surface iron into pyrrhotite. Through collaboration with Montano, it was next possible to postulate and obtain experimental evidence for the chemical mechanism of how H_2S and iron act synergistically to promote liquefaction. This detailed surface chemistry has now been published. Hydrogen sulfide promotes the hydrocracking of all model compounds. The principal mechanism given for this is via SH aromatic pi-orbital attack followed by decoupling of the substituent. Bibenzyl follows an unusual mechanism. 29 refs., 17 tabs.

33538 **(DOE/PC/60783—T3) Study of the kinetics of hydrogenation using aged catalysts. Final technical progress report, 1 October 1983-30 October 1985.** Schweighardt, F.K. (Air Products and Chemicals, Inc., Allentown, PA (USA)). Dec 1985. Contract FG22-83PC60783. 68p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86009295.

We have demonstrated that a l-liter Robinson reactor can be used to quantify the aging characteristics of Wilsonville hydrotreater catalyst, Shell No. 324M. We compared the derived, lumped kinetic constants measured by Sandia National Labs. in a 15-ml microautoclave (tubing bomb reactor) on the identical catalyst samples shared with this program. Our results show the two reactor systems are sensitive to the carbon coking and pore mouth blocking that affect the rate of pyrene hydrogenation. The program objective was to determine the catalytic hydrogenation of coal liquid model compounds using authentically aged catalysts. Results of the program quantified the change in rate of hydrogenation pyrene as a function of the process age of the Wilsonville Pilot Plant. Comparison of whole pellet and crushed catalyst (Sandia Labs.) showed carbon coating and metals deposition blocking pores of active sites, thereby reducing overall hydrogenation activity by 20 to 25%. The range of the apparent kinetic constants, calculated from the Robinson reactor data, is 2 to 3 times greater than those calculated from the microautoclave. Both reactor systems show the absolute trend in decrease of hydrogenation potential with whole aged pellets. The rate constants derived for crushed catalyst from the microautoclave were a factor of 10 higher than the whole pellet constants. This is due to the exposure of new surface area with crushing, which normalizes the aging effect. Comparing the methods as analytical tools clearly favors the microautoclave technique with whole pellets. Comparing the methods as research tools to model the kinetics of hydrogenation of a bulk catalyst (pellets) the Robinson reactor allows for more precise data acquisition, with reduced catalyst sampling error and a closer approximation of the "true" activity of the catalyst as a function of coking and metal deposition. 21 refs., 10 tabs.

33539 **(DOE/PC/70018—17) Coal liquefaction process solvent characterization and evaluation. Annual report, January 1-December 31, 1985.** Winschel, R.A.; Robbins, G.A.; Burke, F.P. (Conoco, Inc., Library, PA (USA). Coal Research Div.). Feb 1986. Contract AC22-84PC70018. 72p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86009018.

Conoco Coal Research Division is characterizing samples of direct coal liquefaction process oils based on a variety of analytical techniques to provide a detailed description of the chemical composition of the oils, to more fully understand the interrelationship of process oil composition and process operations, to aid in plant operation, and to lead to process improvements. The approach taken is to obtain analyses of a large number of well-defined process oils taken during periods of known operating conditions and known process performance. Close cooperation is maintained with the process developers and with DOE in order to maximize the benefits of the work. Analytical methods used are based on their ability to provide quantitatively valid measures of process oil composition. Particular use is made of methods which provide chemical/molecular information of proven relevance to process performance. In addition, all samples are treated using conventional methods of analysis and preparation so that unit performance parameters, such as conversions and yields, can be independently determined to assure sample validity and correlation of analytical results among various plant operations. An appendix has been entered separately into EDB and ERA. 8 refs., 1 fig., 8 tabs.

33540 **(DOE/PC/70018—17, pp 42-67) Composition of recycle oil from HRI's Catalytic Two-Stage Liquefaction process.** Winschel, R.A.; Robbins, G.A.; Burke, F.P. Feb 1986. NTIS, PC A04/MF A01. File Number DE86009018.

In Coal liquefaction process solvent characterization and evaluation. Annual report, January 1-December 31, 1985.

The Catalytic Two-Stage Liquefaction (CTSL) process being developed by Hydrocarbon Research, Inc. uses two ebullated-bed catalytic reactors in series to convert coal to distillate oils. The performance of the process with bituminous coal was demonstrated in Run 227-20 which was operated at constant conditions for 25 days with a single charge of catalyst. Over the course of the run, the second-stage heavy products (recycle oils) decreased in quality. The resid content of the oil increased. The resid product became more aromatic and more phenolic and increased in preasphaltene content. The distillate product became more aromatic and phenolic. The ability of the second-stage product to convert coal under donor conditions decreased. The likely cause of the decrease in second-stage product quality is catalyst deactivation. Hydrogenation, hydrocracking and deoxygenation functions all appear to be directly or indirectly affected. Despite this evidence of catalyst deactivation, Run 227-20 demonstrated a significantly improved yield structure as compared to results of H-Coal processing of bituminous coal. The heavy products (recycle oils) are significantly less aromatic (more hydrogenated) and contain fewer preasphaltenes than H-Coal oils. Catalyst deactivation rates, based on rates of change of measured product oil properties as a function of high temperature catalyst age, are significantly less for CTSL Run 227-20 than for comparable H-Coal operations. 6 refs., 10 figs.

33541 **(DOE/PC/70787—T5) Supercritical water based liquefaction. Quarterly report No. 6, December 1, 1985-March 14, 1986.** Stenberg, V.I. (North Dakota Univ., Grand Forks (USA)). [1986]. Contract FG22-84PC70787. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86010922.

In 1984, we began using H_2O-H_2S as a substitute for organic, hydrogen-donor pasting solvents for coal liquefaction. Our attention was focused on the solution to apparently insoluble problems which the organic solvent pose. They are (1) the slow rehydrogenation of the oxidized organic solvent (after hydrogen donation), (2) the disappearance of good hydrogen donating solvent molecules such as tetralin into the less or more volatile coal fractions during repeated cycles of the solvent and (3) the isomerization of good organic hydrogen donor molecules into poorer quality species during liquefaction. The philosophy for the use of H_2O-H_2S is that the water fulfills the role of the slurrying liquid and H_2S is the hydrogen atom donor. Water becomes supercritical at 374°C, and its supercritical state has the potential of influencing the liquefaction processes in several ways: (1) it becomes a fine solvent for hydrocarbons, (2) loses much of its ability to dissolve inorganic material, (3) adds to the reaction pressure, and (4) becomes more ionic (acidic and basic) since the ionization constant increases by ca. 3 powers of ten. If water is to be substituted for an organic slurrying liquid, the increase in reaction pressure (to ca. 5000 psi) must be tolerated. Therefore, one must insist there be compensating factors for this pressure increase which more than make up for the cost of increased operating pressures. Batch autoclave data now indicate this is so. Indeed, water appears to have a positive effect on liquefaction yields in addition to its role as a slurrying liquid. The philosophy behind the temperature programmed reactions was the belief that the thermally-produced, coal-derived radicals would be formed in a more controllable fashion, i.e., in a more steady, slower rate. 11 refs., 3 figs., 6 tabs.

33542 **(DOE/PC/70787—T6) Supercritical water based liquefaction. Quarterly report No. 5, September 15, 1985-December 14, 1985.** Stenberg, V.I. (North Dakota Univ., Grand Forks (USA)). [1986]. Contract FG22-84PC70787. 12p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86010921.

The philosophy behind the temperature programmed reactions was the belief that the thermally-produced, coal-derived radicals would be formed in a more controllable fashion, i.e., in a more steady, slower rate, within the coal-water slurry than with a sudden thermal jump to a preselected reaction temperature. The latter is as-

sumed to momentarily deplete the hydrogen donor capacity of the solvent system at least in the vicinity of the thermal reaction events. In the case where water is the principal solvent, the hydrogen donor capacity is proportional to the H_2S concentration. The consequence of this depletion is the occurrence of retrograde reactions which result in lower conversions. The data of Table 1 compare the H_2O-H_2S results along with those using (1) a petroleum-coal based organic solvent, anthracene oil (A04) together with a solvent refined coal middle distillate from the demonstration plant at Tacoma, Washington (SRCMD) and (2) dihydrophenanthrene (DHP), a repeatedly excellent hydrogen donor solvent. In summary, the H_2O-H_2S solvent runs with various ranks of coals, gave respectable yields of total volatile materials at 420°C; and, with temperature programming the reactor from 300° to 500°C, the yields were as good if not better than using one of the best of hydrogen donor model compound solvents. The H_2S concentration, the programming rates or ranges have not been optimized. 11 refs., 4 tabs.

33543 (DOE/PC/70790—T6) Thermodynamic and transport properties for polar coal mixtures. Technical progress report, January 1-March 31, 1986. Stiel, L.I. (Polytechnic Inst. of New York, Brooklyn (USA)). [1986]. Contract FG22-84PC70790. 16p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86011175.

During this period values of the infinite dilution activity coefficient, $\gamma_1/\sup \infty/$, have been measured for nonpolar and polar solutes in quinoline for 25 to 80°C and in diphenylmethane for 60 to 70°C. The data have been compared with values presented in the literature for these solvents. The experimental data are also being utilized in conjunction with the analytical procedures being developed in this investigation for the determination of the phase behavior of polar coal mixtures from the parameters of the components. Measurements were made with Chromosorb W Acid Washed substrate and the less polar support Chromosorb W DMCS. Comparable results were obtained for the two supports to within the experimental error. In Figure 1 to 4 values of ln $\gamma_1/\sup \infty/$ are plotted against 1/T for the representative solutes n-hexane, acetone, ethyl acetate, and benzene. For n-hexane the experimental values of $\gamma_1/\sup \infty/$ have only a slight temperature dependence for this range and are in closer agreement with the values of Desty and Swanton than that of Thomas et al. For the polar solutes acetone and ethyl acetate, the values of $\gamma_1/\sup \infty/$ decrease slightly with decreasing temperature, as shown in Figures 2 and 3. The extrapolated values for these solutes are in agreement with the values of Thomas et al. at 20°C. For benzene, the experimental values from this study are intermediate to the values presented by other investigators. 6 refs.

33544 (DOE/PC/70799—T6) Identification of nonvolatile coal derived products via chromatography coupled with on-line FTIR detection. Quarterly progress report, December 1, 1985-February 28, 1986. Taylor, L.T. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)). May 1986. Contract FG22-84PC70799. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010930.

Many of the same properties that make supercritical fluids advantageous in chromatography also enhance their ability to extract compounds from within a sample matrix. Also, since the solubility of most compounds is dependent on the density of the supercritical fluid, selective extraction is possible. These properties are well known, and have been exploited in some cases where the extraction was formerly done with a liquid. In many cases, the quality of extract is higher, and extractions are of higher efficiency than with liquids. Supercritical fluids, especially CO_2, are also often less expensive, less toxic and less flammable than their organic liquid phase counterparts. With the demonstration of supercritical fluid extraction, an obvious extension would be to extract or dissolve the compounds of interest into the supercritical fluid before analysis with SFC. This would be analogous to the case in HPLC, where the mobile phase solvent is commonly used for dissolving the sample. The work described here employs a system capable of extracting materials with a supercritical fluid and introducing a known volume of this extract onto the column for analysis via SFC. Detection of the separated materials is by on-line uv spectroscopy and infrared spectrometry. The optimized SFE/SFC system has been used to study selected nonvolatile coal-derived products. The work reported here involved the aliphatic and aromatic hydrocarbon fractions from this residuum material. Residua were taken from the reactor at several times and examined which provided some insight into the effects of catalyst decay on the products produced in a pilot plant operation. 9 refs., 6 figs.

33545 (DOE/PC/80009—T9) Cooperative research in coal liquefaction infratechnology and generic technology development. Monthly report. Sendlein, L.V.A. (Kentucky Univ., Lexington (USA). Inst. for Mining and Minerals Research). 1986. Contract FC22-85PC80009. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010687.

Progress reports are presented for the following tasks: (1) biologically improved coal structure for better liquefaction of coal; (2) coprocessing of coal with coal with heavy oil and petroleum residuals; (3) liquefaction research in pyrolysis, catalysis and coal dissolution; (4) integrated coal liquefaction/characterization; (5) basic process/resource evaluation task; (6) technology assessment and forecasting. (AT)

33546 (DOE/PC/80906—2) Catalytic methods for improved coal liquefaction and hydrotreating. Quarterly report No. 2, December 23, 1985-March 22, 1986. Hirschon, A.S.; Laine, R.M.; Wilson, R.B. Jr. (SRI International, Menlo Park, CA (USA)). Mar 1986. Contract FG22-85PC80906. 49p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86010749.

The goal of this project is to optimize the reaction conditions for coal liquefaction and upgrading coal liquids. Results for this quarter are summarized by task. Task 1, Synthesis of Catalysts. From our surface-confined catalysts and doped conventional catalysts, we found that the molybdenum(II) tetraallyl surface-confined catalysts were superior to conventionally made catalysts. We also raised the activation temperature of one catalyst from 200°C to 400°C and found that higher activation temperatures resulted in improved activity. Task 2, HDN Activity of Catalysts with Model Systems. We compared the effects of molybdenum(II) tetraallyl and molybdenum tetraacetate precursors and found that the allyl derivative was far superior. We also tested the effect of hydrogen pressure on the HDN activity of the ruthenium-doped CoMo catalyst and found that the amount of hydrogenation is greatly decreased compared with the C-N bond cleavage with lower hydrogen pressure. Thus, we can selectively cleave C-N bonds, which is the first step in our efforts to form a more selective HDN process. Also, to determine if other additives enhance the HDN process, we added tungsten carbonyl to the CoMo catalyst. However, no enhancement in the HDN activity of the catalyst was observed. Task 3, Catalytic Reactions and Additives on Coal and Coal Liquids. We found that adding acid to either quinoline or tetrahydroquinoline under HDN conditions results in no reaction unless a catalyst is added. A summary of the effects of additives is also presented under this task. 19 refs., 15 figs., 7 tabs.

33547 (DOE/PC/81201—T1) Microbial removal of organic sulfur from coal. First quarterly report, October-December 1985. Fannin, K.F.; Conrad, J.R.; Maka, A. (Institute of Gas Technology, Chicago, IL (USA)). Feb 1986. Contract AC22-85PC81201. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86010609.

The specific objectives of the project are: (1) to improve or develop inocula from previous enrichment studies and from a coal storage area soil on model sulfur compounds aerobic and anaerobic conditions; (2) to determine the effects of process conditions on the efficiencies and rates of the microbiological removal of organic sulfur from coal; and (3) to develop a conceptual process design and perform an economic evaluation of the proposed design. The work performed during this quarter was primarily directed toward culture enrichments using a single model compound, dibenzothiophene (DBT). These studies were designed to verify the ability of existing cultures to degrade DBT and to develop new cultures demonstrating degradation of this model compound. Preliminary data indicate that three aerobic cultures enriched from coal storage areas, demonstrated effective degradation of DBT. The cultures are comprised of mixed bacterial populations. (JDB)

33548 (EPRI-AP—4509) Lignite in Texaco gasification-based-combined-cycle power plants. Final report. McNamee, G.P.; White, G.A. (Energy Conversion Systems, Inc., Los Angeles, CA (USA)). Apr 1986. 271p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920289.

This report presents the results of a comparative study of Texaco-based integrated gasification combined cycle (IGCC) power plants firing both an Illinois No. 6 bituminous coal and a Texas lignite. All designs considered in this report employ current gas turbines technology (2000°F firing temperature) and meet the emission requirements of the 1979 Federal New Source Performance Standards for steam power plants. This study had three major objectives: To evaluate the performance impact of the unit processes operating in support of gasification and to identify their potential for improvement when lignites are used; to determine the relative cost of producing power from low-rank and high-rank coals in Texaco-based IGCC plants; and to identify and evaluate alternative methods of feeding lignite to the gasifier. To meet the first objective, a series of tradeoff studies were performed and the results incorporated into the overall plant arrangement. To meet the second and third objectives, 11 complete 1000-MW-capacity, Texaco-based, grass roots IGCC plant designs and cost estimates were prepared. The results of these cases support the following conclusion: Because lignite has a lower cost per million Btu's than high-rank coals, texaco-based IGCC plants firing lignite have the potential to generate power more cheaply than plants firing high-rank coals; several different lignite fielding systems may be used to realize these lower costs; and the efficiency of power generation is nominally the same for lignites and for bituminous coals when a proper coal feed system is used and the moisture content of both types is the same. 24 figs., 16 tabs.

33549 (EPRI-AP—4579) Development of high-chromium ferritic clad heat exchanger tubing. Cox, T.B.; Sponseller, D.L. (AMAX Materials Research Center, Ann Arbor, MI (USA)). May 1986. 94p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920283.

High chromium, corrosion resistant alloys are required to withstand the high temperatures and corrosive environment of coal gasification plants such as the Cool Water facility. The production of tubing for heat exchangers from high alloy materials is a priority goal of the EPRI gasification materials program. Because many high chromium alloys are very expensive and have little elevated temperature strength, it would be advantageous to clad the outside surface of low alloy, elevated temperature steel tubes with the corrosion resistant alloy and rely on the low alloy steel for structural strength. Evaluation of commercial alloys for possible use as monolithic or coextruded tubes identified four compositions suitable for evaporator tube applications and four compositions for superheater applications. In addition, a series of alloys containing 30% chromium were evaluated for their ability to be coextruded with 1.25Cr-0.5Mo steel, undergo welding and resist gasification corrosion. An alloy, nominally 30Cr-2Ni-2Mo, was successfully coextruded to various tubing sizes and provided to EPRI for testing in the Cool Water gasification plant. 18 refs., 28 figs., 28 tabs.

33550 (EPRI-AP—4589) Corrosion of refractories in a synthetic coal slag. Final report. Greenberg, S.; Poeppel, R.B. (Argonne National Lab., IL (USA)). May 1986. Contract W-31-109-ENG-38. 55p. NTIS, PC A04/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303; GPO Dep. File Number DE86011177.

The effects of slag temperature and slag velocity on the corrosion of chromia-containing refractories were studied in a rotating-cylinder test furnace. In this furnace, 1-in.-diam x 1-in.-high refractory cylinders are rotated at a controlled rotational speed (50 to 150 rpm) in slag of known composition, under controlled temperature (1500 and 1600°C) and oxygen partial pressure ($\sim 10^{-9}$ atm) conditions. Refractories containing 60 to 80% Cr_2O_3 showed negligible corrosion at 1500°C. At 1600°C, significant differences between refractories of similar composition were apparent, particularly at high rotational speeds. Subtle mineralogical differences among the various high-chromia refractories are the apparent cause of the differences in corrosion rates. Low-chromia (10% Cr_2O_3) refractories showed greatly accelerated corrosion rates in comparison with the high-chromia refractories. 9 refs., 29 figs., 3 tabs.

33551 (IS-M—569) Chemical desulfurization of coal with Caro's acid. Lin, K.L.; Liu, D.C.; Markuszewski, R.; Bautista, R.G. (Ames Lab., IA (USA); Iowa State Univ. of Science and Technology, Ames (USA). Dept. of Chemical Engineering). 1985. Contract W-7405-ENG-82. 12p. (CONF-850982—3). NTIS, PC A02. File Number DE86011435.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

The effects of the amount and concentration of Caro's acid (H_2SO_5), the temperature, presence of hydrogen perioxide, and coal particle size on the desulfurization of coal have been investigated. Caro's acid was prepared from ammonium peroxydisulfate and sulfuric acid using a commercial procedure and was analyzed by conventional techniques. A typical preparation contained 11 to 14 H_2SO_5, 0.1 to 0.7 H_2O_2, 0.5 $H_2S_2O_8$, and 10 to 11.5 H_2SO_4 (all in wt %). Its desulfurization potential was tested on an Illinois No. 6 run-of-mine coal with a heating value of 9134 Btu/lb. Using -100 mesh coal, 10 wt % Caro's acid, and a pulp density of 16%, it was possible to remove about 55% of the total sulfur from coal in one hour while stirring at an ambient temperature of 23°C. The recovery of coal and the recovery of heating value were about 90%. The percent desulfurization, leaching of iron, and consumption of Caro's acid were studied at different reaction conditions. The reaction was exothermic; raising the temperature above ambient did not improve the desulfurization appreciably, but it did increase the consumption of Caro's acid. The presence of hydrogen peroxide in Caro's acid also did not provide any advantage in the desulfurization scheme. The ratio of Caro's acid to the amount of pyritic sulfur in coal was more important than the absolute amount or concentration of H_2SO_5. Using coal particles greater than 70 mesh increased the leaching time required for maximum desulfurization, while using coal finer than 200 mesh resulted in greater consumption of Caro's acid. Under best conditions, about 5.3 moles of Caro's acid were consumed per mole of sulfur removed, corresponding to about 140% of the theoretical value required for the oxidation of pyrite. Nevertheless, its consumption was much lower than that of H_2O_2 + H_2SO_4 mixtures in related schemes for coal desulfurization. 16 refs., 16 figs., 2 tabs.

33552 (LA-UR—86-1887) Investigations of sulfur tolerance of water-gas shift catalysts. Campbell, C.T. (Los Alamos National Lab., NM (USA); Indiana Univ., Bloomington (USA). Dept. of Chemistry). 1986. Contract W-7405-ENG-36. 11p. (CONF-860649—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011227.

From 6. annual gasification contractors' meeting; Morgantown, WV, USA (24 Jun 1986).

The interaction of H_2S with Cu(111) has been investigated. The adsorption proceeds dissociatively, with evolution of H_2 gas and deposition of S/sub a/. At 300K, the sticking probability (0.02) is constant up to nearly saturation coverage. By 650K, the dissociative sticking probability has decreased by a factor of 3.5. Removal of S/sub a/ using H_2 pressures up to 1000 torr was impossible, indicating a very slow reverse reaction. This helps explain why such low levels of sulfur can completely poison Cu-based catalysts. Figure 1 shows the influence of pre-adsorbed sulfur on the activity of Cu(111) for WGS at 10 torr H_2O, 26 torr CO and 625K. There is a linear decay in rate up to saturation coverage, where the rate drops to zero. This linear decay indicates a simple site-blocking mechanism for sulfur poisoning, with only a small ensemble of free Cu sites (≤ 2) required for the WGS reaction. The Cu(111) surface was dosed with Cs from a droplet of CsOH solution in ultra-pure water, which was dried by heating mildly (375K, 1 min) in air. The cesium coverage was controlled by the initial Cs concentration in solution. The Cs-dosed catalyst has been characterized by XPS and ISS. Under WGS reaction conditions, the surface was reduced to a state involving, at most, one oxygen atom per Cs adatom. Figure 2 shows the influence of Cs upon the WGS kinetics at 625K, 10 torr H_2O and 26 torr CO. There is a nearly linear increase in catalyst activity with Cs coverage until a p(2 x 2) LEED pattern appears after reaction (θ/sub Cs/ = 0.25). At this point, the activity is some 15x higher than for unpromoted Cu(111). Pure Cs on Cu(111) also gives a p(2 x 2) LEED pattern at saturation (θ/sub Cs/ = 0.25). For the optimally-promoted surface, the reaction order with respect to H_2O was the same as for clean Cu(111), and the activation energy increased slightly to 23 kcal/mole^{-1}.

33553 (PB—86-157468/XAB) User's manual for the Gas Research Institute coal-gasification environmental, health, and safety information system. Brown, G.E.; Meserole, N.P.; Esh-Sheikh, J. (Radian Corp., Austin, TX (USA)). Sep 1985. 71p. NTIS, PC A04/MF A01.

GRI has developed an information system to provide member companies and other participating researchers access to a carefully screened collection of technical information relevant to controlling potential environmental, health, and safety (EH&S) impacts of coal gasification. The information system does not contain data, but rather a short review of that data or other information, and a rating of its pertinent aspects. The contents are accessible through a computerized system of keyword assignments and bibliographic data for relevant documents, and a manual perusal of reference summary sheets prepared by technical reviewers. Hardcopies of all documents are available at Radian Corporation, and selected documents which are considered key references and are broad in scope are located in GRI's technical library. The purpose of the manual is to describe the GRI EH&S Information System and its operation. The discussion is in three parts that describe how information is entered, how information is handled, and suggestions on how to formulate search criteria. The Appendix (GRI-85/0181.1) contains the command file listings for the database.

33554 (PNL—5805) Effects of coal rank on the chemical composition and toxicological activity of coal liquefaction materials. Wright, C.W.; Dauble, D.D. (Pacific Northwest Labs., Richland, WA (USA)). May 1986. Contract AC06-76RL01830. 67p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86011015.

This report presents data from the chemical analysis and toxicological testing of coal liquefaction materials from the EDS and H-Coal processes operated using different ranks of coal. Samples of recycle solvent from the bottoms recycle mode of the EDS direct coal liquefaction process derived from bituminous, sub-bituminous, and lignite coals were analyzed. In addition, the H-Coal heavy fuel oils derived from bituminous and sub-bituminous coals were analyzed. Chemical methods of analysis included adsoprtion column chromatography, high-resolution gas chromatography, gas chromatography/mass spectrometry, and low-voltage probe-inlet mass spectrometry. The toxicological activity of selected samples was evaluated using the standard microbial mutagenicity assay, an initiation/promotion assay for mouse-skin tumorigenicity, and a static bioassy with Daphnia magna for aquatic toxicity of the water-soluble fractions. 22 refs., 16 figs., 14 tabs.

33555 (SAND—81-6003) Process for extracting useful, primarily combustible gases by in-situ gasification of underground fossil-fuel beds. Ljuengstroem, F. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1981. 7p. NTIS$5.00.

A patented Swedish method for igniting underground beds of coal or shale for in-situ gasification involves drilling several holes to the fuel bed and inserting electrical heating elements down some of them. A small portion of the bed is heated electrically and brought to a gas-permeable state. Oxygen introduced through one or more of the holes makes the surrounding zones of the fuel bed burn; the combustible gases generated escape through the other drilled holes.

33556 Status of underground coal gasification. Stephens, D.R.; Hill, R.W.; Borg, I.Y. (Lawrence Livermore National Lab., CA). *American Association of Petroleum Geologists, Bulletin;* 69: No. 2, 309(Feb 1985). (CONF-850322—).

From American Association of Petroleum Geologists annual meeting; New Orleans, LA, USA (25 Mar 1985).

Underground coal gasification appears to be one of the most attractive routes for synfuels from coal because the process can produce methanol and substitute natural gas at prices competitive with existing energy sources. The technical feasibility of underground coal gasification has been well established by small-scale field tests. Cost estimates based on the resultant data are favorable. The environmental effects associated with the technology appear to be acceptable. Successful commercialization of the process would probably triple the proven reserves of US coal, which would be sufficient to last for hundreds of years. At this stage of development, underground coal gasification is a high-risk technology and will remain so until large-scale field tests are successfully carried out. These tests are recommended by the Gas Research Institute and by the American Institute of Chemical Engineers. A 7-yr program costing about $200 million would permit initial commercial production in 10 yr.

33557 Sulfur reduction potential of the coals of the Northern Appalachian Region. Maronde, C.P.; Deurbrouck, A.W. (Coal Preparation Div., Pittsburgh Energy Tech. Center, U.S. Dept. of Energy). pp 17-34 of Coal Prep 85. Lexington, KY; Coal Mining (1985). (CONF-850464—).

From Coal preparation conference and exhibition; Lexington, KY, USA (30 Apr 1985).

Coal is the dominant fossil energy resource of the United States. However, the hazardous nature of the impurities in coal raises serious questions about it's long-term acceptability and eventual cost of utilization. Foremost among the noxious impurities in coal is sulfur, which volatilizes during combustion and is emitted with the off-gases into the atmosphere as SO/sub X/. It is the reduction in the amount of this sulfur being emitted to the atmosphere that this paper addresses. In general, there are three recognized strategies to reduce sulfur emission levels: Fuel Switching - a strategy whereby low sulfur coals are substituted for high sulfur coals now being utilized. While this strategy appears to provide a straightforward solution, it has some inherent economic and social disadvantages. If the low sulfur coal is of lower Btu content or has different combustion characteristics, it will result in boiler derating. Furthermore, switching fuels often results in the loss of local mining jobs; Flue Gas Scrubbing - an expensive method to reduce sulfur that has questionable application where the life expentancy of existing boilers is less than 10 years. Further, the sludge generated as scrubber waste presents environmental problems; Coal Preparation - the simplest and least expensive way to reduce the sulfur content of U.S. coals, particularly those of the Midwest and Appalachian Regions.

33558 Progress in the Laporte LPMEOH PDU Project. Mednick, R.L.; Losek, J. (Chem Systems Inc.). pp 219-258 of Coal technology '85. Volumes 5 and 6. Houston, TX; Industrial Presentations (1985). (CONF-851108—).

From 8. international coal utilization conference and exhibition; Houston, TX, USA (12 Nov 1985).

Air Products and Chemicals, Inc. and the U.S. Department of Energy, as part of DOE's indirect liquefaction program, are engaged in a project to prove the feasibility of the Liquid Phase Methanol (LPMEOH) Process at a Process Development Unit (PDU) scale. Chem Systems Inc., the inventor of the process, is the key subcontractor in the program. Air Products has been joined by the Electric Power Research Institute and Fluor Engineers Inc. as private cost-sharing participants supporting the project. In the first phase of the program, a DOE-owned, skid-mounted pilot plant was disassembled and components were revitalized. The unit was reengineered and expanded for service as the LPMEOH PDU, and was relocated to Air Products' LaPorte, Texas industrial gas facility. At this site, pipeline H_2 and pipeline CO are readily available and it is easy to vary the ratio of CO to H_2 fed to the methanol reactor over a very wide range. In the initial operation of the PDU in 1984, three runs were performed of 6, 10, and 40-days duration. These tests provided important information on the effect of process variables, and also demonstrated the need to remove certain trace contaminants to very low detection levels. As a result of these tests, modifications were made to the PDU during early 1985. A second 40-day, continuous run with CO-rich synthesis gas has now been accomplished. In this run, catalyst activity and activity maintenance were excellent, even better than performance established in bench-scale reactors. Some 186 metric tons of crude methanol were produced with a methanol purity of 96 percent. The PDU on-stream factor was 97 percent. The success of this run was a major milestone in the LaPorte project. Another 10-day run at LaPorte was also performed, with concentrated catalyst slurry. High methanol production was achieved. Further bench-scale research and LaPorte planning are now underway.

0105 By-products

REFER ALSO TO CITATION(S) 33721

33559 Crystallizetion and properties of glasses prepared from Illinois coal fly ash. DeGuire, E.J.; Risbud, S.H. (Univ. of Illinois, Urbana-Champaign,). *Journal of Materials Science;* **19**: 1760-1766(1984). Contract AC02-76ER01198.

Glasses synthesized from Illinois coal fly ash by conventional melt quenching were recrystallized by suitable nucleation and crystal growth heat treatments. The microstructure and selected properties of the glasses and crystallized glasses were investigated using scanning and scanning transmission electron microscopy (SEM, STEM), Moessbauer spectroscopy, differential thermal analysis (DTA) and X-ray diffraction (XRD). Crystallization of the fly ash glasses without the aid of added nucleating agents was possible up to a maximum of ~ 23 vol%. The crystalline phase was tentatively identified on the basis of STEM microanalysis as a combination of ferroaugite [$(Ca, Fe^{2+})(Al, Fe^{3+})_2SiO_6$] and potassium melilite [$KCaAlSi_2O_7$]. Comparative results of the thermal expansion, density and microhardness of the glass and crystallized glass are reported along with the Young's modulus of a glass fiber pulled from the fly ash melt. 16 references, 5 figures, 4 tables.

0106 Properties

REFER ALSO TO CITATION(S) 33496, 33497, 33498, 33499, 33501, 33502, 33503, 33504, 33505, 33506, 33507, 33508, 33509, 33510, 33511, 33512, 33513, 33514, 33516, 33522, 33544, 33554, 33634, 33636, 33644, 33655, 33656, 34385, 34393, 34435

33560 (DOE/FE/60181—41) New approaches to the characterization of lignites: a combined geological and chemical study. Schobert, H.H.; Karner, F.R.; Olson, E.S.; Kleesattel, D.R.; Zygarlicke, C.J. (North Dakota Univ., Grand Forks (USA). Energy Research Center). May 1986. Contract FC21-83FE60181. 28p. (CONF-841210—32). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86010902.

From International chemical congress of Pacific Basin Society; Honolulu, HI, USA (16 Dec 1984).

One of the characteristics of low-rank coals which serves, on a molecular level, to distinguish them from bituminous coals is the close association of some of the inorganic constituents with the organic structure. In particular, most of the alkali and alkaline earth elements are accounted for as cations associated with carboxylic acid groups. Some minor elements occur in part as coordination complexes with organically bound sulfur and nitrogen. In addition, the porous, woody structure provides many sites for authigenic mineralization. Some of the resulting minerals are finely disseminated within the coal matrix to such an extent that they are not separable by traditional float/sink methods. The most important consequence of the close interrelationship between the inorganic constituents and the organic structure is that low-rank coals cannot be characterized adequately by research which focuses solely on either the organic or the inorganic portion of the coal. Studies of both portions must be carried out in an integrated program to gain a proper understanding of this very complex material. This report illustrates this thesis with data from research now in progress on characterization of the Beulah-Zap lignite, North Dakota. The Beulah-Zap bed is a part of Paleocene Sentinel Butte Formation in the Fort Union coal basin, which lies in the northern Great Plains and encompasses portions of western North Dakota, eastern Montana, and northwestern South Dakota, as well as portions of southern Saskatchewan and Manitoba in Canada. Several reasons are given for the selection of the Beulah-Zap seam for detailed geological and chemical study. 39 refs., 2 figs., 13 tabs.

33561 (DOE/METC—86-4061) Application of the polycyclic aromatic hydrocarbon relative retention index to rapid gas chromatographic analysis of DOE/METC gasifier samples. Hesbach, P.A.; Lamey, S.C.; Green, W.C. (USDOE Morgantown Energy Technology Center, WV). Feb 1986. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86006605.

The Department of Energy (DOE), Morgantown Energy Technology Center (METC), is involved in the characterization of organic components present in the process and by-product streams generated by coal gasification in DOE/METC's 42-inch stirred fixed-bed gasifier. The primary obective of this characterization program is the generation of basic data on the total organic loadings in various process and by-product streams and the distribution of organic compounds at critical points throughout the cleanup system. The samples collected are initially separated into solid, water-soluble, and tar and oil fractions. Organic solvent extracts of the tars and oils are then subjected to capillary column gas chromatography and gas chromatography/mass spectrometry analysis. Because of the number of components typically present in the tar and oil extracts, identification of every compound is very time-consuming. In response to this, a rapid gas chromatographic identification procedure to analyze organic compounds in tar and oil extracts using a relative retention index (RRI) system has been developed by Argonne National Laboratory (ANL). This system and accompanying software has been used in the analysis and identification of samples from the DOE/METC gasifier. The results, which are processed into a convenient from by the software, can be used to build a data base to allow further analyses, such as the correlation of the composition of process streams with gasifier operating conditions. 9 refs., 4 figs., 5 tabs.

33562 (DOE/PC/80521—T3) Acid-base properties of coals and other solids. Quarterly report, March 1-May 31, 1986. Arnett, E.M. (Duke Univ., Durham, NC (USA). Dept. of Chemistry). 1986. Contract FG22-85PC80521. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010872.

Heats of interaction of various bases with silica gel in hexane were determined with a Tronac 1250 Titration Calorimeter (see Annual report 1983-1984). All heats were measured at 25.0°C. An excess of silica gel 2 to 3 grams, was present as a slurry in hexane in a dewar. A calibrated Gilmont syringe was used for delivery of a known amount of base, dissolved in hexane, into the dewar for reaction with silica. Heats of interaction were determined in kcal/mole. The new approach towards the study of silica, which is presented in this report, emphasizes this difference between surface sites and some of the less accessible ones. A number of the poor correlations which were reported earlier used heats of immersion. The present study presents results in terms of "heats of interaction" (ΔH/sub int/) obtained through the thermometric titration of a slurry of the silica in hexane. A solution of the base is pumped at a steady rate into the slurry in a Tronac calorimeter so that the heat evolved during the titration can be followed as a function of time and added equivalents of base. Table III compares heats of immersion with such heats of interaction and Figure 1 plots these two properties against each other. Heats of immersion are of necessity presented in terms of calories per gram of silica since there is no simple means for determining how many moles of base are adsorbed per gram. On the other hand titration calorimetry allows immediate determination of the amount of heat in terms of calories per moles of base adsorbed and so is more easily related to customary thermodynamic data. 7 refs., 6 figs., 3 tabs.

33563 (DOE/PETC/TR—86/5) Analyses of tipple and delivered samples of coal collected during fiscal year 1984. Welsh, R.A.; Davis, L.R. (USDOE Pittsburgh Energy Technology Center, PA). May 1986. 39p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86011321.

This Department of Energy (DOE) publication updates a series of Topical Reports (formerly "Reports of Investigation") on the quality of coal purchases under specifications for government use. Listed in alphabetical order by state, county, town, and mine are analytical data on the composition and quality of tipple and delivered samples of coal collected during the fiscal year 1984. Tipple samples were collected by certified commercial laboratories in accordance with instructions given by the Coal Sampling and Inspection Office (CSIO). The delivered samples were collected at destination by installation personnel, and all samples were analyzed under the supervision of the DOE Coal Analytical Laboratory located in the Pittsburgh Energy Technology Center (PETC), Pittsburgh, Pennsylvania, or the US Army General Materiel and Petroleum Activity Laboratory, located at New Cumberland, Pennsylvania. 1 tab.

33564 (PB—86-163748/XAB) Physical and chemical properties of finely ground de-ashed coal. Interim report, April 1984-March 1985. Feldkirchner, H.L.; Anderson, G.L.; Zabransky, R.F.; Hill, A.H.; Chan, I.H. (Institute of Gas Technology, Chicago, IL (USA)). Oct 1985. 80p. NTIS, PC A05/MF A01.

The report presents the results of a laboratory-scale program conducted to determine the physical and chemical properties, including gasification, of a finely ground de-ashed Pittsburgh No. 8 bituminous coal. Tests were conducted to isolate the effects of fine grinding from those due to fine grinding plus de-ashing. Tests were conducted on the parent coal, on fine-ground coal and after de-ashing by the Otisca T-process. The physical properties measured included: particle-size distribution, surface area, pore structure, true, particle and bulk densities, and fluidization characteristics. The chemical properties measured were ultimate and proximate analyses, free-swelling index, ash-fusion temperature, ash composition and fluorine content, and coal devolatilization and char gasification characteristics.

33585 (PB—86-168788/XAB) Laser-induced free-radical reactions. Final report, February 1982-January 1985. Clark, J.H. (California Univ., Berkeley (USA). Dept. of Chemistry). Oct 1985. 42p. NTIS, PC A03/MF A01.

The solvation dynamics of electronically excited 3-aminophthalimide and 4-aminophthalimide were investigated using picosecond, time-resolved, emission spectroscopy. The results show that: (1) the rate-limiting process for the solvation dynamics of these molecules is the dielectric relaxation of the surrounding solvent molecules; (2) the excited-state solvation dynamics can be predicted from the known longitudinal dielectric relaxation rates of the solvent; and (3) the solute molecules are static while the solvent reorganizes around them. These findings constitute the first direct measurements of solvation dynamics that can be directly compared with the predictions of the various theoretical treatments of the solvation process.

0108 Waste Management

REFER ALSO TO CITATION(S) 33519, 33520, 33958, 34733, 34735, 34752, 34854

33566 (DOE/FE/60177—0043) Biological treatment of underground coal gasification wastewaters. Bryant, C.W. Jr.; Humenick, M.J.; Cawein, C.C.; Nolan, B.T. III. (Western Research Inst., Laramie, WY (USA)). May 1985. Contract FC21-83FE60177. 65p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86010743.

Biotreatability studies using underground coal gasification (UCG) wastewaters were performed by the University of Arizona and the University of Wyoming. The University of Arizona researchers found that UCG condensate could be effectively treated by activated sludge, using feed wastewaters of up to 50% strength. Total organic carbon (TOC) and chemical oxygen demand (COD) removals approached 90% during this research. The University of Wyoming researchers found that solvent extraction and hot-gas stripping were effective pretreatments for undiluted UCG condensate and that addition of powdered activated carbon enhanced the biotreatment process. TOC and COD removals resulting from the combination of pretreatments and biotreatment were 91% and 95%, respectively. The yield, decay, and substrate removal rate coefficients were greater in the University of Wyoming study than in the University of Arizona study. This was possibly caused by removing bioinhibitory substances, such as ammonia, with pretreatment. 18 refs., 25 figs., 6 tabs.

33567 (DOE/FE/60181—173) PDU scale nitrification/denitrification of pretreated coal gasification wastewater. Gallagher, J.R.; Shockey, R.E.; Turner, C.D.; Mayer, G.G. (North Dakota Univ., Grand Forks (USA). Energy Research Center). 1986. Contract FC21-83FE60181. 34p. (CONF-860527—1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86010578.

From 41. annual Purdue industrial waste conference; West Lafayette, IN, USA (13 May 1986).

Cooling tower tests with the stripped gas liquor (SGL) demonstrated that biological treatment to reduce the organic loading was sufficient for satisfactory operation of the tower at 10 cycles of concentration. However, ammonia stripping remained at high levels, which could result in industrial hygiene and nuisance odor concerns, environmental damage and, after longer periods of acclimation, lead to biofouling in the cooling tower from nitrification. These concerns coupled dishcharge to receiving waters, prompted research into biological nitrogen removal. As a result of this research, the following conclusions have been drawn: (1) Great Plains Gasification Plant (GPGP) stripped gas liquor, pretreated by biological oxidation, can be nitrified. Complete nitrification can be obtained at influent concentrations of greater than 500 mg/l as NH_3-N. (2) The highest removal rates and best system stability was found at the highest solids retention time (SRT). The low SRT reactor (12 days) did not attain stable operation until after approximately 110 days of operation. The ammonia removals during steady-state operation were 97.7%, 96.9% and 96.9%, respectively for reactors N1 through N3 (SRTs of 37, 21 and 12 days). (3) Influent ammonia-N spikes up to 1020 mg/l were observed. At these high levels, inhibition was observed at all three SRTs. However, when concentrations fell to typical values (500 mg/l NH_3-N) the systems recovered rapidly. (4) Denitrification of biologically treated and nitrified GPGP SGL was complete in an activated sludge reactor using a 4 day HRT, 10 day SRT and a 2.47:1 molar ratio of methanol to NO_3-N as the supplemental carbon source. (5) Nitrate-N concentrations in the influent greater than 750 mg/l were completely denitrified demonstrating a maximum observed specific removal rate of 92.8 mg NO_3-N/mg MLVSS-day. 16 refs., 10 figs., 4 tabs.

33568 (DOE/FE/60181—180) Photolysis and radiant flash pyrolysis of coal-derived wastes. Worman, J.J.; Worman, J.J.; Hawthorne, S.B.; Sears, R.E. (North Dakota Univ., Grand Forks (USA). Energy Research Center). 1986. Contract FC21-83FE60181. 8p. (CONF-860615—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010577.

From Renewable energy conference; Winnipeg, Canada (23 Jun 1986).

It is attractive to think that coal-derived wastes could be converted to useful fuels by irradiation with solar energy. This would eliminate energy-intensive steps in the processing of coal gasification condensate water as well as provide an inexpensive alternate source of energy. Environmental concerns for the distribution of contaminants from biosludge would be minimized. This paper demonstrates that coal gasification condensate water in the presence of photoconductors and varying wavelengths of light can produce useful fuels in addition to lowering the total organic carbon content. Biosludge obtained from the processing of the condensate water can be irradiated in the solid state with a high-intensity xenon flash to give fuel-type products as identified by GC/MS. 13 refs., 2 figs., 4 tabs.

33569 (DOE/PC/80541—T2) Study of some wastewater contaminants. Second quarterly report, December 16, 1985-March 15, 1986. Wilson, R.F. (Texas Southern Univ., Houston (USA). Dept. of Chemistry). [1986]. Contract FG22-85PC80541. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86009063.

Results are discussed from liquid-liquid extraction studies on coal tar phenols and metal complexes using different liquid pairs, concentrations, ionic strengths, and pH's.

33570 (EPRI-CS—4390-Vol.1, pp 1.23-1.46) Role of FGD and SO_2 reduction strategies for coal-fired power plants. Rubin, E.S.; Cushey, M.; Marnicio, R.J.; Bloyd, C.N.; Skea, J.K. (Carnegie-Mellon Univ., Pittsburgh, PA). Jan 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920169. (CONF-850630—Vol.1).

From 9. symposium on flue gas desulfurization; Cincinnati, OH, USA (4 Jun 1985).

A newly developed computer model for detailed analysis of SO_2 control strategies and costs at the unit, state and regional levels is described. Illustrative results are presented in which a broad range of parameters affecting FGD retrofits at existing coal-fired power plants are examined for an eight-state region of the midwest,

using site-specific plant and fuel characteristics. The future cost and capacity of FGD retrofit systems is seen to depend strongly on SO_2 reduction requirements. For the highest levels of control, wet limestone scrubbing in conjunction with physical coal cleaning often provided the most economical means of compliance, particularly if only local coals were used. The future availability of dry SO_2 removal processes (lime spray dryer and LIMB) is seen to have a potentially significant influence on the choice of SO_2 control technology, should emission reductions of 50% or more become required in the next decade. The potential effects of plant life extension programs on the use of conventional and advanced FGD systems also is significant. The way in which overall SO_2 emission reductions are allocated to individual sources, and the degree to which utility coal choices are constrained, also have a pronounced effect on control technology selection and cost. 16 references, 4 figures, 7 tables.

33571 (EPRI-CS—4390-Vol.1, pp 2.1-2.16) **Present and future status of FGD in the United States.** McIlvaine, R.W. (McIlvaine Co., Northbrook, IL). Jan 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920169. (CONF-850630—Vol.1).

From 9. symposium on flue gas desulfurization; Cincinnati, OH, USA (4 Jun 1985).

More than 50,000 megawatts of FGD systems are in operation in the United States. More than 100,000 megawatts will be in operation by 1991. An upsurge in new boiler orders beginning in the next few years will raise the FGD total to close to 175,000 megawatts in the US by the late 1990's. Acid rain control could be an important factor in determining this total but variations in peak load demand and boiler replacement rates will be more significant long term. The commercial situation is constantly changing. Architect engineers, boiler companies, scrubber system designers and component suppliers are attempting to take more responsibility. This is spurring competition among these groups as well as among individual suppliers. Integration, new technology and internationalization are also shaping the competitive environment. 7 references, 6 figures, 1 table.

33572 (EPRI-CS—4390-Vol.1, pp 2.17-2.28) **Survey report and assessment of utility flue gas desulfurization system installations in Europe.** Ellison, W. (Ellison Consultants, Monrovia, MD). Jan 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920169. (CONF-850630—Vol.1).

From 9. symposium on flue gas desulfurization; Cincinnati, OH, USA (4 Jun 1985).

This paper presents details of recent surveys of major programs for flue gas desulfurization (FGD) and NO/sub x/ removal installation in West Germany. The purpose of the paper is to provide an understanding of the principal types of control system designs that are being applied, to outline technological advancements that are being achieved, and to describe operating experience gained to date in expanded use of FGD and selective catalytic reduction (SCR) in Europe in the 1980s. Significant differences from FGD and NO/sub x/ removal practice in USA and Japan are reviewed and specific information that may serve to help improve operation and reliability of new and retrofit installations in USA is offered. 5 references, 9 tables.

33573 (EPRI-CS—4390-Vol.1, pp 2.29-2.54) **Recent developments in SO_2 and NO/sub x/ abatement technology in Japan.** Ando, J. (Chuo Univ., Tokyo, Japan). Jan 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920169. (CONF-850630—Vol.1).

From 9. symposium on flue gas desulfurization; Cincinnati, OH, USA (4 Jun 1985).

More than 1400 FGD plants have been constructed in Japan with a total capacity of treating 130,000,000 Nm^3/h of flue gas (43,000 MW equivalent). Thirty FGD plants have been operated treating about 90% of total flue gas from coal-fired utility boilers. All of the FGD plants for coal by-produce salable gypsum. On the other hand, the total capacity of selective catalytic reduction (SCR) of NO/sub x/ exceeded 90,000,000 Nm^3/h (30,000 MW). Twenty coal-fired boilers use SCR in addition to FGD. All of the FGD and SCR plants have been operated with over 99% reliability. The investment cost for limestone/gypsum process FGD plants for coal-fired boilers has been lowered from about 30,000 yen/kW in 1979-1980 to about 20,000 yen/kW in 1983-1984. The power consumption of the FGD processes was also reduced from 2.1-2.6% to 1.7-2.1%. The annualized cost of the wet limestone/gypsum process is currently about 1.4 yen/kWh including 7 years depreciation and 10% interest. The investment cost of SCR for coal-fired utility boilers is about 6000 yen/kW, while the annualized SCR cost is 0.5-0.6 yen/kWh including 7 years depreciation and 10% interest. For the removal of acid (H^+), NO/sub x/ abatement by combustion modification (CM) is the most economical, while SCR is more costly. There have been no significant developments in simultaneous SO_2 and NO/sub x/ removal technology except that two test plants have been operated with activated carbon processes. Several industrial coal-fired boilers using fluidized-bed combustion have been put into operation, reducing both SO_2 and NO/sub x/. 10 references, 9 figures, 9 tables.

33574 (EPRI-CS—4390-Vol.1, pp 2.55-2.58) **EPA's stationary source control technology research program.** Gerber, C.R. (Environmental Protection Agency, Washington, DC). Jan 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920169. (CONF-850630—Vol.1).

From 9. symposium on flue gas desulfurization; Cincinnati, OH, USA (4 Jun 1985).

Research to reduce NO/sub x/ emissions has focused on combustion modification. The major thrust has been to develop the technology for new low-NO/sub x/ burners that may be retrofitted to existing boilers or incorporated into new designs. The program is also exploring advanced combustion techniques. Two of these second generation burners have shown the potential to reduce NO/sub x/ emissions by more than 50% from current NSPS levels for pulverized, coal-fired units. The research on particulate technologies involves cleaning of flue gases subsequent to combustion. Electrostatic precipitators are the most commonly used means; fabric filters are the major alternative to electrostatic precipitators for particle control. The major problems with ESPs and fabric filters are their high costs and their operational uncertainties. The research program in this area is directed toward reducing costs by as much as 50% and minimizing operational uncertainties.

33575 (EPRI-CS—4390-Vol.1, pp 3.1-3.15) **Results of using organic acid in San Miguel Electric's flux gas desulfurization system.** Burke, J.M.; Cmiel, R.; Mobley, J.D. (Radian Corp., Austin, TX). Jan 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920169. (CONF-850630—Vol.1).

From 9. symposium on flue gas desulfurization; Cincinnati, OH, USA (4 Jun 1985).

This paper summarizes San Miguel Electric Cooperative's first full year of operation after conversion of the Unit 1 flue gas desulfurization (FGD) system to an organic acid enhanced limestone system. Plant operating data from 1983 (without organic acid addition) and 1984 (with organic acid addition) were reviewed. Based on that review, changes which occurred once organic acids were added to the system were identified and cost savings resulting from those change estimated. The cost estimates showed that savings directly attributable to organic acid use exceeded the cost for organic acid by $109,000 in 1984. Further, additional cost benefits resulting from organic acid use may have been in excess of $3 million. Because of this positive experience, San Miguel continues to use organic acid in the FGD system. 3 references, 3 figures, 2 tables.

33576 (EPRI-CS—4390-Vol.1, pp 3.17-3.31) **State-of-the-art design applications on a closed-loop FGD system.** Laslo, D.; Bakke, E. (Peabody Process Systems, Inc., Norwalk, CT). Jan 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920169. (CONF-850630—Vol.1).

From 9. symposium on flue gas desulfurization; Cincinnati, OH, USA (4 Jun 1985).

Seminole Electric Cooperative's Unit 1 and Unit 2 in Palatka, Florida are capable of 1240 MW of generating power. The limestone-based flue gas desulfurization systems for both boilers incorporate an organic acid addition system for operation at high dissolved salt concentrations, and, on Unit 1, a unique double draw-off

crystallizer unit operation for improved cake dewatering, and a two-tank forced oxidation system for production of gypsum. Discussions include full scale closed-loop water management and operating experience, results from a commercial gypsum dewatering pilot plant, the results of double draw-off product removal on both calcium sulfite and calcium sulfate crystals, and, operating experience and economics of organic acid addition. Also, the results of a successful test of sodium thiosulfate addition as a gypsum scale inhibitor will be presented. 17 references, 4 figures, 5 tables.

33577 (EPRI-CS—4390-Vol.1, pp 3.33-3.64) **Dibasic acid test and chemical process evaluation at Petersburg Unit 3 FGD system.** Guetig, D.; Ou, S.; Wedig, C.P. (Indianapolis Power & Light Co., Petersburg, IN). Jan 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920169. (CONF-850630—Vol.1).

From 9. symposium on flue gas desulfurization; Cincinnati, OH, USA (4 Jun 1985).

The use of dibasic acid (DBA) in a flue gas desulfurization (FGD) system buffers the scrubber chemistry, resulting in increased scrubber SO_2 removal efficiency. The use of DBA may also result in reduced scrubber electricity consumption. It is expected that Indianapolis Power & Light Company's (IPL) Petersburg Unit 3 can burn higher sulfur coal when using DBA in the scrubber, while maintaining its current 30-day average SO_2 control. However, long-term effects of factors that may limit scrubber performance (e.g., demister pluggage or dewatering equipment performance) have yet to be determined. Other effects of DBA addition, such as increased corrosion rates, also must be considered in long-term use of DBA. The use of DBA at Petersburg Unit 3 did not reduce limestone consumption. The use of DBA on an annual basis or on an as-needed basis may result in increased scrubber reliability in that scrubber SO_2 emission excursions may be minimized. In addition, operation of the scrubber with DBA, lower booster fan inlet vane settings, and continued use of presently available coal should result in increased scrubber reliability because wet gas recirculation to the booster fans will be minimized. 3 references, 1 figure, 5 tables.

33578 (EPRI-CS—4390-Vol.1, pp 3.65-3.90) **Operating results of Toyama Kyodo Electric Power's Chiyoda THOROUGHBRED 121 Flue Gas Desulfurization system.** Wataya, K.; Hori, A.; Hashimoto, N.; Koshizuka, H.; Clasen, D.D. (Toyama Khodo Electric Power Co., Japan). Jan 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920169. (CONF-850630—Vol.1).

From 9. symposium on flue gas desulfurization; Cincinnati, OH, USA (4 Jun 1985).

This paper reviews the design and initial operating experience of two Chiyoda THOROUGHBRED 121 Flue Gas Desulfurization plants installed at Toyama Kyodo Electric Power Company's Toyama Shinko Kyodo power station to treat flue gas from two 200 MW coal-fired boilers. This is the first application of the second generation CT-121 process to large electric utility coal-fired boilers. Each CT-121 unit consists of a single scrubber and limestone slurry preparation and gypsum dewatering equipment. Each unit is also equipped with a Ljungstrom type gas-gas heat exchanger for reheating scrubbed flue gas. Plant operation, since startup in July 1984 (Unit 1) and August 1984 (Unit 2) has been smooth and trouble free. The plants are operated at a SO_2 removal efficiency of 85 percent. Limestone utilization is greater than 99 percent and the dry, gypsum by-product is sold to cement and wallboard manufacturers. Plant reliability, including shakedown operations, has been superb, 99.9 percent for Unit 1 and 100% for Unit 2. Inspection of the system following shakedown operation revealed no scaling, plugging or corrosion problems. Maintenance has been limited to routine and general servicing of equipment. 14 figures, 9 tables.

33579 (EPRI-CS—4390-Vol.1, pp 4.1-4.7) **Sulfur dioxide removal system improvement program at seven units of Louisville Gas and Electric Company.** McInnis, M.L.; Froelich, D.A.; Bjorklun, S.A.; Graves, G.M. (Louisville Gas and Electric Co., KY). Jan 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920169. (CONF-850630—Vol.1).

From 9. symposium on flue gas desulfurization; Cincinnati, OH, USA (4 Jun 1985).

During the early part of 1983, Louisville Gas & Electric Company (LG & E) implemented a program to upgrade their mid-1970 vintage sulfur dioxide removal systems (SDRS) to current design standards. The goal of the project was to improve SDRS reliability to a minimum level of 90 percent while reducing excessive operating and maintenance expenses. This program is at its midpoint, with design and construction proceeding at the Mill Creek Station. Problem identification and engineering recommendations are in the evaluation stage for two of the units at Cane Run. Design is proceeding for the third Cane Run unit. The project scope is summarized, and the unique problems encountered with the SDRS improvement program are highlighted. 1 table.

33580 (EPRI-CS—4390-Vol.1, pp 4.9-4.31) **Improving the reliability of Indianapolis Power & Light Company's Petersburg 3 limestone FGD system.** Colley, J.D.; Wolsiffer, S.; Stewart, D.; Rhudy, R.; Balfour, D. (Radian Corp., Austin, TX). Jan 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920169. (CONF-850630—Vol.1).

From 9. symposium on flue gas desulfurization; Cincinnati, OH, USA (4 Jun 1985).

Preliminary results of a comprehensive program to improve the reliability of Indianapolis Power and Light Company's Petersburg 3 FGD system are presented. The objective was to identify the causes of the process problems and recommended solutions to the system's reliability problems. FGD operating guidelines developed from the information gathered during on-site testing are given. Severe mist eliminator scaling was investigated, and recommended procedures were to select better control instrumentation for the scrubbers, to determine proper operating setpoints for pH and density and to modify the mist eliminator wash system. Other testing and modifications to the system are: to install and document operation of three different mechanical seals for recycle pumps; to modify limestone grinding circuit, then install a particle size monitor to determine if the monitor can indicate circuit maintenance frequency; to optimize adipic acid use as other process changes are made; and study the problem of stack opacity as process modifications are implemented. 1 reference, 11 figures, 2 tables.

33581 (EPRI-CS—4390-Vol.1, pp 4.33-4.54) **Results of an FGD process troubleshooting program at Texas Utilities, Martin Lake Steam Electric Station.** Colley, D.; Mzyk, D.; Wadlington, M.; Stewart, D. (Radian Corp., Austin, TX). Jan 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920169. (CONF-850630—Vol.1).

From 9. symposium on flue gas desulfurization; Cincinnati, OH, USA (4 Jun 1985).

The objectives of the troubleshooting program at the Martin Lake Station were to reduce the operating and maintenance costs and to improve reliability of the limestone FGD system. The problem areas addressed include chemical scaling in the absorber packing and mist eliminators, process control and instrumentation, system water balance, and limestone utilization. The troubleshooting methodology used to solve the problems is outlined. A three-month demonstration test was undertaken to verify the success of recommended process changes to reduce gypsum scale formation rates and to improve process stability. The results of the demonstration testing showed that scale formation in the absorber packing and mist eliminator could be virtually eliminated. Recommendations to convert the FGD system from a water producer to a water consumer are listed. Also, recommendations to increase limestone utilization are presented.

33582 (EPRI-CS—4390-Vol.1, pp 4.55-4.67) **Availability analyses for flue gas desulfurization improvement decisions.** Cunningham, A.R.; Smith, M.J. (Philadelphia Electric Co., PA). Jan 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920169. (CONF-850630—Vol.1).

From 9. symposium on flue gas desulfurization; Cincinnati, OH, USA (4 Jun 1985).

A recent study was sponsored by the Electric Power Research Institute (EPRI) to determine the usefulness of availability analysis techniques for guiding decisions involving improvements

on flue gas desulfurization (FGD) systems. This study was directed by Mr. Morton J. Smith, and involved the active participation of personnel at Philadelphia Electric Company (PECo) under the direction of Mr. Albert R. Cunningham. The study concluded that availability analyses can provide significant insight into the consequences of alternative decisions faced by the reponsible FGD plant personnel. These decisions can relate to matters of FGD design, operation, and/or maintenance, and can affect various levels of the system hierarchy from the overall FGD system to individual components. In addition, the results indicated that these analyses can provide plant personnel with additional value at the process variable level if the availability analysis can be combined with FGD performance models. 3 figures, 5 tables.

33583 (EPRI-CS—4390-Vol.1, pp 4.71-4.89) **Study of sulfur-nitrogen compounds in wet lime/limestone FGD systems.** Jarvis, J.B.; Nassos, P.A.; Stewart, D.A. (Radian Corp., Austin, TX). Jan 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920169. (CONF-850630—Vol.1).

From 9. symposium on flue gas desulfurization; Cincinnati, OH, USA (4 Jun 1985).

This paper summarizes the results of an EPRI-sponsored program to study the relationships between sulfur-nitrogen (S-N) compounds and the wet lime/limestone FGD process. S-N compounds have been identified in the Arapahoe pilot-scale FGD system and are formed through a liquid phase reaction between SO_2 and NO/sub x/ absorbed from boiler flue gas. The program objectives were to identify the factors which promote S-N compound formation in wet FGD systems and determine if the presence of these compounds changes system performance. A three-phase program was conducted which included analytical methods development, bench-scale process simulation, and pilot testing at EPRI's Arapahoe test facility. The test results include the identification of various S-N species in solution and a description of how FGD process conditions effect NO/sub x/ removal, S-N formation, and the steady-state concentrations of S-N related species in FGD systems. The test results indicate that the accumulation of S-N compounds can cause a decrease in both SO_2 removal efficiency and operating pH. In most systems, however, the concentrations of S-N compounds are expected to be low enough such that the impact on SO_2 removal efficiency is not significant. 5 references, 2 figures, 3 tables.

33584 (EPRI-CS—4390-Vol.1, pp 4.91-4.112) **Thiosulfate as an oxidation inhibitor in flue gas desulfurization processes: a review of R & D results.** Rochelle, G.T.; Owens, D.R.; Chang, J.C.S.; Brna, T.G. (Univ. of Texas, Austin). Jan 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920169. (CONF-850630—Vol.1).

From 9. symposium on flue gas desulfurization; Cincinnati, OH, USA (4 Jun 1985).

Sodium thiosulfate ($Na_2S_2O_3$) has been tested in a pilot plant as an oxidation inhibitor in flue gas desulfurization by lime and limestone slurry scrubbing with and without MgO and adipic acid additives. The effectiveness of thiosulfate is proportional to the inhibitor product, defined as the product of thiosulfate concentration(M), calcium concentration(M), and the moles of SO_2 absorbed per hour per liter of hold tank volume. Gypsum saturation was less than 100% and scaling was eliminated when the inhibitor product exceeded 0.3×10^{-6} M^3/hr. Thiosulfate was relatively more effective in systems with chlorides and less effective in systems promoted by MgO. An inhibitor product greater than 10^{-6} M^3/hr significantly enhanced dewatering of solids from limestone scrubbing. SO_2 removal and/or limestone utilization were increased in systems that started with less than 10 mM dissolved calcium. 56 references, 10 figures, 3 tables.

33585 (EPRI-CS—4390-Vol.1, pp 4.113-4.130) **Lime slaking using stirred mills.** Dharmarajan, N.N.; Forbus, R.D. (Central and South West Services, Inc., Dallas, TX). Jan 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920169. (CONF-850630—Vol.1).

From 9. symposium on flue gas desulfurization; Cincinnati, OH, USA (4 Jun 1985).

The large tonnages of reagent consumed in lime-based Flue Gas Desulfurization (FGD) processes require that the lime reagent be slaked at the point of use for maximizing economy of operation. The slaking process, which involves mixing the lime with a controlled quantity of water, yields a suspension of extremely fine calcium hydroxide crystals in water. Analysis of commercially available slaking equipment indicated design, operating and maintenance limitations for our spray dryer FGD project. This necessitated our investigation of new methods for slaking lime. The vertical stirred mill appeared to offer several advantages that are desirable. Some of the perceived advantages were simplicity of design, ease of construction, reduced installed cost, ease of operation and maintenance and reduced energy costs. To evaluate its primary function of producing optimum quality slaked product and also to validate some of the desirable inherent features, a pilot program was conducted to test a vertical stirred mill for possible inclusion in our FGD design. This paper presents the equipment features and performance results of our pilot evaluation of a vertical stirred mill in lime slaking service. The many desirable features of the vertical stirred mill will be highlighted to support its selection for Coleto Creek Unit 2 Dry FGD lime-based process. Our selection of the stirred mill in lime slaking is the first known use in the United States for a commercial FGD system. 6 figures, 8 tables.

33586 (EPRI-CS—4390-Vol.1, pp 4.131-4.148) **Limestone selection and preparation for FGD.** Stewart, D.; Colley, J.D.; Hargrove, O.W.; Jones, A.J. (Electric Power Research Institute, Palo Alto, CA). Jan 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920169. (CONF-850630—Vol.1).

From 9. symposium on flue gas desulfurization; Cincinnati, OH, USA (4 Jun 1985).

Limestone properties and preparation for conventional wet scrubbing flue gas desulfurization systems have been investigated in the laboratory and pilot plant with some full-scale tests for comparison. Major factors affecting limestone performance are the pH of the scrubber liquor and the particle size distribution of the limestone. Utilization of the reagent is above 90% when the stone is ground to > 90% passing through 325 mesh. To accomplish this grinding, the wet ball mill and tower mill have the greatest efficiency and lowest system cost. Because of the decreased requirement for -325 mesh limestone, a system to grind to 90% -325 mesh is less costly then a system producing only 80% -200 mesh. Limestone tests at the Duck Creek station of Central Illinois Light Co. show that two of the stones tested are less than current supply and can maintain desired SO_2 removal. Laboratory evaluation of these limestones did not completely define their behavior at full scale. 8 figures, 7 tables.

33587 (EPRI-CS—4390-Vol.1, pp 5.1-5.23) **Failure analysis of FGD system components.** Jones, G.D.; Ellis, P.F. II; Anliker, D.M.; Stewart, D.A. (Radian Corp., Research Triangle Park, NC). Jan 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920169. (CONF-850630—Vol.1).

From 9. symposium on flue gas desulfurization; Cincinnati, OH, USA (4 Jun 1985).

As part of a program sponsored by the Electric Power Research Institute (EPRI), Radian has analyzed equipment failures at several flue gas desulfurization (FGD) system installations. Both metallic and non-metallic material failures were encountered. Failures of non-metallic components include a variety of organic coatings applied to vessel walls and rubber include a variety of organic coatings applied to vessel walls and rubber linings applied to vessel walls and pump impellers. The metallic failures include air sparger anchors, nozzles, a limestone storage tank and an agitator shaft. While in some cases the failure was associated with installation, in most cases the failure was attributed to inappropriate materials or improper process operation. In each instance, the most probable cause of failure was determined and recommendations made to alleviate future occurrences. Several of the analyses and solutions are applicable to other systems where similar problems have occurred. The results illustrate how failure analysis of chronic problems can reduce the maintenance requirements of the FGD system. 14 references, 14 figures, 3 tables.

33588 (EPRI-CS—4390-Vol.1, pp 5.25-5.49) **Performance of duct and stack materials in wet FGD systems.** Rosenberg, H.S.; Koch, G.H.; Kistler, C.W. Jr.; Beavers, J.A.; Meadows, M.L.; Stewart, D.A. (Battelle's Columbus Labs., OH). Jan 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920169. (CONF-850630—Vol.1).

From 9. symposium on flue gas desulfurization; Cincinnati, OH, USA (4 Jun 1985).

In previous field surveys of construction materials for wet FGD systems on utility boilers, it was found that the major problem areas are outlet ducts and stacks. These components are critical in that a failure may result in complete loss of generating capacity for lengthy periods. Accordingly, EPRI is currently funding a study by Battelle on the causes of materials failures in FGD systems. As part of this study, Battelle analyzed the field performance of two outlet duct linings and three stack materials. The duct linings included a glass-flake-reinforced polyester at San Juan and an hydraulically bonded concrete at Gibson. The stack materials included a mica-flake-reinforced polyester lining at Duck Creek, an Alloy 625 flue at Bruce Mansfield, and an acid-resistant brick and mortar flue at Phillips. The latter two materials did not represent actual failures. Field visits were made to each site by a team of specialists to obtain background information, inspect the duct or stack, and collect samples of the materials for detailed analysis. The samples were analyzed by methods such as optical microscopy, scanning electron microscopy/energy dispersive x-ray spectroscopy, x-ray diffraction, and infrared spectroscopy. The results were used to evaluate the performance of the materials. The performance was found to depend upon the environmental conditions within the duct or stack. It appears that the most severe condition occurs when wet scrubbed gas is mixed with hot bypassed gas. Characterization of the environmental conditions is important in all cases in order to identify potential materials problems and develop solutions for them. 8 references, 9 figures, 2 tables.

33589 (EPRI-CS—4390-Vol.1, pp 5.51-5.62) **Leaning brick chimney liners at coal fired power plants.** Dille, E.R.; Krueger, D.L.; Rhudy, R.G. (Burns & McDonnell, Kansas City, MO). Jan 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920169. (CONF-850630—Vol.1).

From 9. symposium on flue gas desulfurization; Cincinnati, OH, USA (4 Jun 1985).

Leaning brick liners in stacks downstream of wet flue gas desulfurization systems are a serious problem that has recently surfaced in the utility industry. The Electric Power Research Institute has initiated a project to evaluate the severity of the problem, identify the cause or causes, and develop preventative measures. This paper documents the currently known information on leaning stacks, including what is known concerning the magnitude and cause of the problem. 1 reference, 4 figures, 5 tables.

33590 (EPRI-CS—4390-Vol.1, pp 5.63-5.74) **Economics of clad metallic fabrication versus solid alloy metal fabrication.** Cloth, E.H.; Kreider, R. (Stone & Webster Engineering Corp., Cherry Hill, NJ). Jan 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920169. (CONF-850630—Vol.1).

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The purpose of this analysis of FGD materials is to provide economic guidance in the selection of a clad metallic fabrication system versus a solid metal fabrication. A simplified FGD tower shell was designed to provide a common basis for the costs. The material and fabrication costs of solid alloys were compared with clad metal fabrications, i.e., roll-bonded, alloy lining, to determine the potential economical savings. Solid alloy materials costs spanned the $2.00 to $11.00 per pound range, which included 316L, an austenitic stainless steel, to C-276, a nickel base alloy. The costs included plate or sheet material costs, weld filler material costs, and welding man-hour costs. The investigation indicates possible savings for clad alloy fabrications over solid alloy fabrications when the solid alloy cost is in the $2.00 to $3.00 per pound range with savings approaching the potential of 30 to 60 percent in the higher-priced alloys such as 625 or C-276. The welding of thin alloy sheets, 1/16 inch and 1/8 inch thick, on a carbon steel shell can also become commercially advantageous in the higher-priced alloys. 4 figures, 6 tables.

33591 (EPRI-CS—4390-Vol.1, pp 5.75-5.86) **Laboratory evaluation as a technique for predicting the behavior of organic coatings in FGD systems.** White, M.L.; Leidheiser, H. Jr.; Koch, G.H. (Lehigh Univ., Bethlehem, PA). Jan 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920169. (CONF-850630—Vol.1).

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A laboratory evaluation of several neat resin systems commonly used as the basis for formulated organic coatings in Flue Gas Desulfurization (FGD) systems was carried out by exposure of coated carbon steel substrates to dilute sulfuric acid at 60°C (140°F) for periods up to 3000 hours. Measurements of corrosion potential, AC conductance, tensile adhesion and weight gain revealed distinct differences in the behavior of the resin types in protection of the steel against corrosion. These results are compared with those obtained in an 18-month field study of formulated coatings (using the same resins as a base material) exposed to the extremely aggressive environment of the outlet mixing zone of the R.D. Morrow, Sr., FGD system. The correlations of resin/coating performance in the actual and simulated FGD environments were investigated with respect to both corrosion protection of the underlying steel and in the modes of failure for those materials that showed poor performance. 13 references, 4 figures, 4 tables.

33592 (EPRI-CS—4390-Vol.2, pp 6.1) **TVA's SO_2 control program.** Hollinden, G.A. (Tennessee Valley Authority, Chattanooga). Jan 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920170. (CONF-850630—Vol.2).

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In the past few years, TVA has implemented various SO_2 emission control procedures on its coal-fired plants, such as coal cleaning, limestone-scrubbing flue gas desulfurization (FGD), and switching to low-sulfur coals. These emission reduction strategies, in combination with conservation and reduced power demand, improved heat rates, and additional nuclear generation, have greatly reduced the quantity of SO_2 emitted by TVA, with the 1983 SO_2 emissions being less than half the 1977 SO_2 emissions. Although great progress has been made, potential changes in SO_2 emission regulations to control acid rain could have profound effects on the use of FGD by TVA and other eastern utilities, e.g., increased use of FGD, upgrading of existing FGD systems, and the accelerated adoption of new technology. With a total FGD capacity of 2500 MW already installed and test facilities for advanced FGD and combustion technology (AFBC) planned, TVA is continuing to assess controlled SO_2 emissions in the future. Even though limestone scrubbing is expected to be the primary method, at least through the rest of the century, innovations, such as the use of additives (adipic and dibasic acid), and new processes, such as limestone double alkali and dry FGD (spray dryer), should increase in importance and move into commercial use in the near future, particularly if the need for wider use of FGD occurs. AFBC, in which SO_2 removal is an integral function, is reaching an advanced stage of development and could serve to reduce the use of FGD at new facilities by the latter half of the 1990's.

33593 (EPRI-CS—4390-Vol.2, pp 6.2) **A/E perspective of retrofitting FGD systems.** Ireland, P.A. (Stearns Catalytic Corp., Denver, CO). Jan 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920170. (CONF-850630—Vol.2).

From 9. symposium on flue gas desulfurization; Cincinnati, OH, USA (4 Jun 1985).

From his perspective as an engineer, the author feels it is important to recognize the true cost of retrofitting an FGD system to an existing plant. He also feels that many acid rain related studies may be underestimating these costs. The author also shares the utility's concerns of minimizing outage time and maintaining existing plant services while the retrofit construction is underway. Often retrofit items can be overlooked such as having to take special precautions when dealing with existing asbestos insulation or having to

hand dig foundations because of underground obstructions. In many instances, FGD process selection of design will be effected by the space available. Finally, if an FGD system retrofit is required for acid rain compliance, an opportunity may exist in some cases to minimize the overall cost by burning a cheaper higher sulfur coal.

33594 (EPRI-CS—4390-Vol.2, pp 6.2) **Changing FGD marketplace.** Martin, J.R. (Combustion Engineering Inc., Birmingham, AL). Jan 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920170. (CONF-850630—Vol.2).

From 9. symposium on flue gas desulfurization; Cincinnati, OH, USA (4 Jun 1985).

The demand in the US for FGD systems at the beginning of this decade was concentrated primarily in the utility sector and consisted primarily of new systems in conjunction with utility capacity additions. During the last five years, we have seen that demand shrink at an average rate of 50% per year to a very low level. During the next five years, however, we expect to see an increase in demand for FGD systems. In part, this new demand will be caused by utility capacity additions, but an increasing demand for emission control systems for refuse recovery, cogeneration, and hazardous waste incineration will have a major impact and FGD system rehabilitation and modifications will also be important. This study will outline the forces that are reshaping the demand for gaseous emission control equipment and how we can expect the technology to adapt to that changing demand.

33595 (EPRI-CS—4390-Vol.2, pp 6.3) **Retrofitting FGD systems.** Feibus, H. (Dept. of Energy, Washington, DC). Jan 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920170. (CONF-850630—Vol.2).

From 9. symposium on flue gas desulfurization; Cincinnati, OH, USA (4 Jun 1985).

In the event that legislation is enacted requiring control of SO_2 emissions from pre-NSPS coal-fired power plants in order to reduce acid rain precursor emissions, commercially available technology is essentially limited to coal cleaning, wet scrubbers, and spray dryers. DOE analyses indicate that commercial coal cleaning is of important but limited value and that the latter two would be prohibitively expensive. Developmental technologies that could be available in the late 1980's to mid-1990's time frame offer the potential of improved performance in terms of cost per unit weight of SO_2. These approaches include advanced coal cleaning processes, furnace sorbent injection, fluidized bed combustion, and duct injection FGD.

33596 (EPRI-CS—4390-Vol.2, pp 6.4-6.5) **Issues in utility SO_2 control retrofit.** Dalton, S.M. (Electric Power Research Institute, Palo Alto, CA). Jan 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920170. (CONF-850630—Vol.2).

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Cost, space, risk, energy, and waste disposal are the main issues facing utilities that are considering a retrofit FGD. Most debates have centered on FGD cost, and have normalized the cost in terms of dollars per ton of SO_2 control. Early estimates range from $560 to $1120 per ton SO_2 removed for conventional wet FGD and $425 to $935 for advanced concepts such as furnace sorbent injection and Chiyoda 121 scrubbing (levelized over 30 years). Several factors cause costs to vary widely. Space constraints can cause costs to increase by two-thirds and will preclude FGD on a few installations. Utilities often are unwilling to accept high risk technologies since they cannot shut down if the process doesn't work. Electric energy used for FGD (1-3% of the plant output) is unavailable to meet the peak loads and be replaced by utilities at premium replacement rates. Waste disposal quantities for midwestern plants can double or even triple in volume compared to untreated plants. These issues make it prudent for utilities to study the alternatives available to them very carefully before committing to a single strategy for their system.

33597 (EPRI-CS—4390-Vol.2, pp 7.1-7.11) **Development and demonstration of a limestone dual alkali FGD process at Central Illinois Public Service Company's Newton Power Station.** Simpson, J.L.; Wilhelm, J.H. (Central Illinois Public Service Co., Springfield). Jan 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920170. (CONF-850630—Vol.2).

From 9. symposium on flue gas desulfurization; Cincinnati, OH, USA (4 Jun 1985).

This study describes the development, implementation and demonstration of the CIPS/CODAN limestone dual alkali process at the 595 MW Newton Power Station of CIPS. The process, the changes required to convert the original lime dual alkali process to the use of limestone, and the operating experience at Newton are described. Costs of development and retrofit are included along with operating cost savings, performance goals and achievements.

33598 (EPRI-CS—4390-Vol.2, pp 7.13-7.26) **Current operating experience and operating costs of double alkali FGD at NIPSCO's R.M. Schahfer Generating Station Unit 17.** Biolchini, R.J.; Boward, W.L.; Camponeschi, B.S. (FMC Corp., Schaumburg, IL). Jan 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920170. (CONF-850630—Vol.2).

From 9. symposium on flue gas desulfurization; Cincinnati, OH, USA (4 Jun 1985).

Operating experience and 1984 operating costs of FMC's Double Alkali flue gas desulfurization system, for the 393 MW, high sulfur coal-fired boiler, at NIPSCO's R.M. Schahfer Generating Station are presented. Test results have shown that the FGD system has met the EPA's 1979 Revised New Source Performance Standards on high sulfur coal and has demonstrated collection efficiencies well above 90%. Average availability during the first two years of operation has been 99.97%. FGD system operating costs for 1984 were on the order of 4 mils/kWh. 3 references, 4 figures, 4 tables.

33599 (EPRI-CS—4390-Vol.2, pp 7.27-7.43) **Current progress at the FMC Limestone Double Alkali demonstration plant.** Boward, W.L. Jr.; Biolchini, R.J.; Wrobel, B.A. (FMC Corp., Schaumburg, IL). Jan 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920170. (CONF-850630—Vol.2).

From 9. symposium on flue gas desulfurization; Cincinnati, OH, USA (4 Jun 1985).

The Limestone Double Alkali (LSDA) flue gas desulfurization process combines the reliability and efficiency of sodium scrubbing with the economical use of limestone as the main reagent. Studies sponsored by EPA and EPRI have shown LSDA to be economically desirable for full scale plants when evaluated against other types of wet scrubbers. An LSDA demonstration plant has been in operation since September, 1984, at Northern Indiana Public Service Company's R.M. Schahfer Station. The demonstration plant treats a flue gas slip stream from Schahfer Unit 17 which burns high sulfur coal. Results of the first test period will be discussed. Period 1 was used to characterize the operation of the system and determine the preferred process settings for the next test. Period 2 will be a long term test of the dependability of the system while maintaining 90% SO_2 removal and following changes in boiler operation. Plans for Period 3, which will determine how well the system responds to stresses, will also be discussed. Results in the areas of SO_2 collection, limestone utilization, soda ash consumption, and filter cake percent solids have been encouraging. This LSDA demonstration plant is jointly funded by FMC, NIPSCO, the Cleveland Electric Illuminating Company and Southern Indiana Gas and Electric Company. Bechtel Group, Incorporated is evaluating the process for EPRI during Periods 2 and 3. 7 references, 7 figures, 1 table.

33600 (EPRI-CS—4390-Vol.2, pp 7.45-7.73) **Effects of limestone type and grind on dual alkali system performance.** Chang, J.C.S.; Brna, T.G.; Kaplan, N. (Acurex Corp., Research Triangle Park, NC). Jan 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920170. (CONF-850630—Vol.2).

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Pilot plant tests were conducted to evaluate the dual alkali system performance with respect to five types and grinds of limestones. The data show that high purity, high calcium, fine grind limestone should be used for the regeneration of dual alkali scrubbing solution. Limestone containing more than 0.5% magnesium is not suitable for dual alkali processes. The accumulation of dissolved magnesium caused performance deterioration and system upset. Experimental techniques which can be used to characterize the limestone reactivities were also evaluated. The reactivities measured by sodium bisulfite titration agreed with pilot plant data. 8 references, 6 figures, 8 tables.

33601 (EPRI-CS—4390-Vol.2, pp 8.1-8.14) **Pilot evaluation of combined particulate and SO_2 removal using a fabric filter system.** Pohl, F.G.; Hooper, R.G.; Bland, V.; McElroy, M.; Rhudy, R. (Southern Research Institute, Birmingham, AL). Jan 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920170. (CONF-850630—Vol.2).

From 9. symposium on flue gas desulfurization; Cincinnati, OH, USA (4 Jun 1985).

Events relevant to the injection of both sodium and calcium reagents into a flue-gas stream ahead of a fabric filter are reviewed and updated. Results are reported from tests conducted at EPRI's Fabric Filter Test Facility at the Arapahoe station of the Public Service Co. of Colorado in Denver, Colorado, and at EPRI's High-Sulfur Coal Pilot Plant at the Scholz station of the Gulf Power Company near Sneads, Florida. With dry-sodium injection, sodium reagent is fed into the flue-gas stream ahead of a baghouse and downstream of the air heater. In the ductwork, sodium carbonate partially reacts with SO_2 in the flue gas to form a dry powder that collects along with the fly ash on the bags as part of the dustcake where it continues to remove SO_2. Results are presented for three sodium reagents - sodium bicarbonate, sodium sesquicarbonate, and sodium carbonate. For each reagent, SO_2 removal is determined as a function of reagent particle size and normalized stoichiometric ratio (NSR), and sodium utilizations are compared. Injection of a dry calcium reagent for SO_2 removal is performed in the same manner as sodium injection except that water or steam is also injected to condition the flue gas to a desired temperature and humidity. In the ductwork, a portion of the lime reacts with SO_2 to form calcium sulfite and calcium sulfate. Preliminary tests with pressure hydrated dolomitic lime are reported, and calcium utilization and SO_2 removal are compared for five calcium reagents - quicklime, pressure hydrated high-calcium lime, conventionally hydrated lime, pressure hydrated dolomitic lime, and precalcined pressure hydrated dolomitic lime. 3 references, 12 figures.

33602 (EPRI-CS—4390-Vol.2, pp 8.15-8.29) **Investigation of combined particulate and SO_2 using E-SOX.** Sparks, L.E.; Plaks, N.; Ramsey, G.H.; Valentine, R.E. (Environmental Protection Agency, Research Triangle Park, NC). Jan 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920170. (CONF-850630—Vol.2).

From 9. symposium on flue gas desulfurization; Cincinnati, OH, USA (4 Jun 1985).

Research aimed at developing a low cost retrofit system, called E-SOX, for combined particulate and SO_2 removal is described. The E-SOX concept centers on recent advances in ESP technology that make it possible to reduce the size of ESPs required for particulate control. Results of mathematical modeling and limited pilot scale experiments on the feasibility of collecting SO_2 in the freed space are discussed. The results show that the concept is technically feasible. Modest (40-65%) levels of SO_2 removal are possible with lime as the reagent. High (over 90%) levels of SO_2 removal are possible with sodium carbonate as the reagent. Order of magnitude economic analysis shows that the process is economically feasible. Plans for additional experimental and theoretical work are presented. 2 references, 11 figures.

33603 (EPRI-CS—4390-Vol.2, pp 8.31-8.43) **Mitsui-BF simultaneous SOx and NOx removal system.** Ito, Y.; Fujimoto, T.; Nagaoka, O. (Mitsui Mining Co., Ltd., Tokyo, Japan). Jan 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920170. (CONF-850630—Vol.2).

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Mitsui Mining Company, Limited (MMC) has been developing the titled system by using activated coke jointly with Mitsui Miike Engineering Corporation (MMEC) by improving a process originated by Bergbau Forschung GmbH (BF) of West Germany. A pilot plant with a capacity of 1000 m^3 N/H has been operated from February, 1981 till September, 1983 at Tochigi Works of MMEC. MMC has achieved success in the long term continuous operation of the pilot plant at an efficiency of more than 99% SOx removal and more than 80% NOx removal by the further improvement of BF System. With the results of test performance, MMC has gained confidence in applying the new technology in a commercial plant. MMC constructed the titled system plant of 30,000 m^3 N/H capacity of MMC Coal-fired Power Station at Omuta, Japan. Its commercial operation began on October 1, 1984 and the plant has been operated satisfactorily so far. MMC has been operating an activated coke (AC) production pilot plant of a capacity of 0.8 ton AC/day in an attempt to produce less expensive AC with better performance. This AC is used in the titled system plant at Omuta and has shown very satisfactory results. After performance test operation based on a design condition at 99% DeSOx and 50% DeNOx was achieved, higher NOx removal efficiency operation (70%-80%) has been started since February, 1985. 1 figure, 3 tables.

33604 (EPRI-CS—4390-Vol.2, pp 8.45-8.59) **Operating experiences and developments with Ljungstroem gas-gas heaters in West German FGD plants.** Clay, D.E. (Kraftanlagen Aktiengesellschaft Heidelberg, West Germany). Jan 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920170. (CONF-850630—Vol.2).

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Regenerative gas-gas heaters have been adopted by the German power industry as the state of the art for reheating scrubbed flue gases. The anticipated fouling and corrosion problems have proved controllable and the first large-scale gas-gas heater entered operation in 1982 at NWK Wilhelmshaven. Since then more than 11.000 operating hours have been achieved. Two novel features are incorporated in the design - a cold side plastic heating element and an on-line high-pressure washing system. Anticipated future SO_2 emission limits of 200 mg/Nm^3 have led to a low leakage design (0.3-0.5%). The operating experiences and developments with the regenerative gas-gas heater will be discussed. 1 reference, 12 figures, 1 table.

33605 (EPRI-CS—4390-Vol.2, pp 8.61-8.80) **SOXAL process.** Mani, K.N.; Chlanda, F.P. (Allied Corp., Mt. Bethel, NJ). Jan 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920170. (CONF-850630—Vol.2).

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The SOXAL process is a regenerative wet scrubbing system which produces a concentrated sulfur dioxide stream and is applicable for low to high sulfur coals. The sulfur dioxide can be liquified, converted to sulfuric acid or elemental sulfur. The process is based on the use of a high pH sodium solution as a scrubbing medium to remove the sulfur oxides from the flue gas. The product solution from the absorber is regenerated electrically using water splitting membranes in which the bisulfite salt is converted to the original sulfite and hydroxide that are recycled and an aqueous solution of SO_2 which is readily stripped to recover concentrated sulfur dioxide. The SOXAL process and the associated membrane technology have been under development at Allied Corporation for over 12 years and are currently being commercialized by its AQUATECH Systems business unit.

33606 (EPRI-CS—4390-Vol.2, pp 9.1-9.22) **Spray dryer FGD experience Joy-Niro installations.** Donnelly, J.R.; Wilson, S.; Matis, L.P.; Eriksen, R.; Emerson, R.D.; Fooks, J.C. (A/S Niro Atomizer, Soeberg, Denmark). Jan 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920170. (CONF-850630—Vol.2).

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Joy-Niro lime based Spray Dryer Absorption (SDA) Flue Gas Desulfurization systems are in commercial operation on the following coal-fired utility boilers: Riverside Generating Station - Units 6 & 7; Antelope Valley Station - Unit 1; Holcomb Generating Station - Unit 1; and Rawhide Generating Station - Unit 1. More than nine years of operating experience have been accumulated for these stations. These systems employ spray dryer absorbers, equipped with single rotary atomizers, and reverse air bagfilters for SO_2 and particulate removal. The systems range in size from 600,000 ACFM (110 MW) to 2,100,000 ACFM (450 MW) and treat flue gases from the firing of North Dakota lignite, Powder River Basin subbituminous coal, and a blend of subbituminous coal and petroleum coke. Each system incorporates unique site specific design features for the flue gas cleaning systems and for waste conditioning/disposal. This paper presents a comparison of the plant designs and performance. Compliance/Performance test results are compared to design values. Start-up problems are reviewed and current plant reliability is discussed. Waste conditioning and disposal practices at each site are described and results of physical/chemical tests of the end product are presented. 15 references, 3 figures, 9 tables.

33607 (EPRI-CS—4390-Vol.2, pp 9.23-9.41) **Problem solving and results of performance test at United Power Association Stanton Station Dry FGD system.** Manavizadeh, G.B.; Negrea, S.; Westerlind, G.; Ferguson, A.W. (Research-Cottrell, Inc., Sommerville, NJ). Jan 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920170. (CONF-850630—Vol.2).

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Use of data acquisition and management techniques of solving problems associated with spray dryer and fabric filter are discussed. Methods of cooperation between owner, A/E and the system supplier are highlighted. Results of the first FGD performance test, 60 day reliability test, its inconclusive results and the improvements generated by its data, as well as the preliminary final performance test (one year after the initial test) are presented. A brief description of the system design, field modifications and its operation is presented. Using methods specified by EPA for compliance testing, guaranteed SO_2 removal efficiency and particulate emission were achieved at the UPA Stanton Dry FGD Unit. Preliminary data are also presented on use of sonic horns for reducing pressure drop in fabric filter and their effect on SO_2 removal and particulate emission. 3 references, 3 figures, 4 tables.

33608 (EPRI-CS—4390-Vol.2, pp 9.43-9.64) **High-sulfur spray dryer evaluations.** Robards, R.F.; Aldred, R.W.; Burnett, T.A.; Humphries, L.R.; Widico, M.J. (Tennessee Valley Authority, Chattanooga). Jan 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920170. (CONF-850630—Vol.2).

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The Tennessee Valley Authority initiated a program in 1983 to evaluate a pilot lime spray dryer/baghouse flue gas desulfurization system treating flue gas resulting from the combustion of high-sulfur coal (3.2% S as-fired) at the Shawnee Test Facility. Testing was performed to determine the effects of the major spray dryer operating variables on the spray dryer, the baghouse, and the overall SO_2 removal efficiencies of the system. Variables which were evaluated include lime stoichiometry, approach-to-saturation temperature, recycled solids, flue gas residence time in the spray dryer, atomizer speed, and inlet flue gas temperature. As expected, the SO_2 removal efficiency is a strong function of lime stoichiometry and approach-to-saturation temperature. Recycled solids and the inlet flue gas temperature are also important while atomizer speed and residence time seem to have little, if any, impact over the ranges tested. The most important conclusion is that a spray dryer/baghouse flue gas desulfurization system can attain a sufficiently high SO_2 removal efficiency to meet a 1.2 lb SO_2/MM Btu emission regulation when treating flue gas resulting from the combustion of high-sulfur coal. However, careful consideration of the major independent variables is necessary to attain this goal. 4 references, 4 figures.

33609 (EPRI-CS—4390-Vol.2, pp 9.65-9.91) **Recent results from the EPRI 2-1/2 MW spray dryer pilot plant.** Rhudy, R.G.; Blythe, G.M. (Electric Power Research Institute, Palo Alto, CA). Jan 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920170. (CONF-850630—Vol.2).

From 9. symposium on flue gas desulfurization; Cincinnati, OH, USA (4 Jun 1985).

Since January 1984, testing on the 2-1/2 MW spray dryer/fabric filter FGD pilot plant has centered on variations to the basic FGD system. Results which are presented demonstrate the effects of the use of several cooling tower blowdown waters for lime slaking and/or process dilution, the effects of calcium chloride as a system performance additive, and the impacts on SO_2 removal of the use of warm (spray dryer inlet) gas bypass around the spray dryer to reheat the fabric filter inlet gas by 20°F to 40°F. Additionally, results are presented which relate process variations to fabric filter performance, such as corrosion tendencies and tubesheet pressure drop. Data are presented which compare the tube sheet pressure drop history for bags in the fabric filter compartment downstream of the spray dryer to that for bags in a control compartment that is filtering hot, untreated flue gas. Finally, data are presented which relate these process variations to the disposal properties of solids collected in the fabric filter. 7 references, 12 figures, 8 tables.

33610 (EPRI-CS—4390-Vol.2, pp 9.93-9.110) **Performance of a spray dryer/ESP flue gas cleanup system during testing at the Pittsburgh Energy Technology Center.** Yeh, J.T.; Drummond, C.J.; Joubert, J.I.; Tulenko, D.M.; Crynack, R.R.; Hochhauser, M.L. (Dept. of Energy, Pittsburgh, PA). Jan 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920170. (CONF-850630—Vol.2).

From 9. symposium on flue gas desulfurization; Cincinnati, OH, USA (4 Jun 1985).

Wheelabrator Air Pollution Control and the US Department of Energy jointly sponsored a project to evaluate the potential for the application of spray dryer flue gas desulfurization (FGD) systems to existing coal-fired boilers equipped with electrostatic precipitators for particulate emissions control. The objectives of this project were to characterize the performance of a spray dryer FGD system using flue gas from the combustion of different types of coal, and to study the effectiveness of an electrostatic precipitator (ESP) in controlling particulate emissions from this system. Three different coals (low-, medium-, and high-sulfur coal) were burned in a 500 lb/hr pulverized-coal combustion test facility at the Pittsburgh Energy Technology Center. Sulfur dioxide was removed from the flue gas by injection of a lime slurry in a spray dryer. Particulate emissions were controlled using a mobile electrostatic precipitator. For each fuel, a three-part test program was conducted. This test program consisted of (1) base-line ESP performance tests without spray dryer operation to determine requirements for fly ash collection; (2) parametric tests defining sulfur dioxide removal efficiency and ESP collection efficiency at various spray dryer operating conditions; and (3) sorbent recycle tests in which the particulate collected by the ESP was recycled by injection into the spray dryer with the fresh sorbent to improve reagent utilization. Test results show that sulfur dioxide removal efficiencies of 90% can be achieved for each of the three coals tested using the combined spray dryer and electrostatic precipitator system for emissions control. 21 references, 4 figures, 4 tables.

33611 (EPRI-CS—4390-Vol.2, pp 9.111-9.124) **Application of electrostatic enhancement of fabric filtration to spray dryer by-product.** Hovis, L.S.; Daniel, B.E.; Chen, Y.J.; Donovan, R.P. (EPA/IERL-RTP, Research Triangle Park, NC). Jan 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920170. (CONF-850630—Vol.2).

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Experiments conducted at small pilot scale show that the pressure drop increase during the fabric filtration of redispersed spray dryer by-product (chiefly calcium salts and fly ash) is significantly reduced through electrostatic enhancement of the filtration. The pressure drop rise for a typical electrostatic augmented fabric filtration (ESFF) is only one-fourth or less than that of the rise for a conventional filtration cycle. The ESFF takes advantage of the relatively lower electrical resistivity of the spray dryer by-product attributable to the high moisture content and to the low temperature at which the filtration of spray dryer by-product is carried out. A low resistivity allows application of greater electrode potentials than can be used at normal fly ash filtration conditions. 8 references, 17 figures, 1 table.

33612 (EPRI-CS—4390-Vol.2, pp 10.1-10.14) **Gypsum by-product FGD system.** Liegois, W.A.; Wicks, D.A. (Stanley Consultants, Inc., Muscatine, IA). Jan 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920170. (CONF-850630—Vol.2).

From 9. symposium on flue gas desulfurization; Cincinnati, OH, USA (4 Jun 1985).

The start-up experiences of the FGD system on Unit 9 of Muscatine Power and Water are summarized. This FGD system has a guaranteed removal efficiency of 96% of the sulfur dioxide from the flue gas and was the first unit in the US designed to produce a gypsum by-product. Operating problems associated with the system are discussed, along with system availability and by-product quality. 2 figures, 3 tables.

33613 (EPRI-CS—4390-Vol.2, pp 10.33-10.51) **Evaluation of engineering properties and wet stacking disposal of Widows Creek FGD gypsum-fly ash waste.** Garlangar, J.E.; Ingra, T.S.; Magliente, S.H.; Crowe, J.L. (Ardaman & Associates, Inc., Orlando, FL). Jan 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920170. (CONF-850630—Vol.2).

From 9. symposium on flue gas desulfurization; Cincinnati, OH, USA (4 Jun 1985).

Wet stacking of by-product gypsum has been practiced by the phosphate fertilizer industry for more than 25 years. The ability to use wet stacking for disposal of flue gas desulfurization (FGD) gypsum was first demonstrated during an Electric Power Research Institute sponsored project on Chiyoda Thoroughbred 121 FGD gypsum produced at the Scholz Electric Generating Station of Gulf Power Company in Sneads, Florida. Wet stacking of FGD gypsum containing fly ash, however, has not been previously demonstrated. Accordingly, as part of an overall project investigating various FGD waste disposal alternatives, the Tennessee Valley Authority constructed a pilot-scale wet stacking disposal facility to evaluate the feasibility of wet stacking FGD gypsum-fly ash waste produced at the Widows Creek Steam Plant in Stevenson, Alabama. Operational experience and results from geotechnical laboratory testing performed on the waste are presented. The results indicate that although the Widows Creek FGD gypsum-fly ash had settling, dewatering, and structural characteristics not as favorable for stacking as phosphogypsum or CT 121 FGD gypsum, they were adequate for wet stacking. Therefore, the project findings should extend the ability of the utility industry to employ wet stacking disposal to facilities which also use FGD/forced oxidation systems as the primary particulate removal process. 8 references, 24 figures.

33614 (EPRI-CS—4390-Vol.2, pp 10.53-10.70) **Solids handling and dewatering optimization at Colorado Ute's Craig Station.** Hargrove, O.W.; Owens, D.R.; Stewart, D.A.; Renner, J. (Radian Corp., Austin, TX). Jan 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920170. (CONF-850630—Vol.2).

From 9. symposium on flue gas desulfurization; Cincinnati, OH, USA (4 Jun 1985).

Units 1 and 2 at Colorado Ute's Craig Station include wet limestone scrubbers for SO_2 emissions control. Because the SO_2 concentration in the gas is very low, the solids formed are completely oxidized. Normally, gypsum produced in a limestone FGD system dewaters and handles relatively well. However, the centrifuge product at Craig fluidizes when shear forces are applied and, as a result, cannot be transported in an open truck. EPRI, Radian, and Colorado Ute have been investigating the poor handling properties of these solids over the past 3 years. The fluid properties of the solids are a result of the fine crystals in the product cake which may be caused by a number of different factors. This paper discusses possible causes of the cake properties and methods to optimize the performance of the dewatering equipment. A comparison of full-scale centrifuge and pilot-scale vacuum filter results is included. 5 figures, 6 tables.

33615 (EPRI-CS—4390-Vol.2, pp 10.71-10.109) **EPRI research on management of wastes from SO_2 control processes.** Golden, D.M.; Boyd, R.H. (Electric Power Research Institute, Palo Alto, CA). Jan 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920170. (CONF-850630—Vol.2).

From 9. symposium on flue gas desulfurization; Cincinnati, OH, USA (4 Jun 1985).

The Electric Power Research Institute is keenly aware of the myriad of issues facing the electric utility industry in the area of controlling flue gas emissions from coal-fired power plants, particularly sulfur oxides. Virtually all facets of the question of how to control SO_2 emissions have been or are under consideration by the Institute in one or more research programs. In closing the loop on the question of SO_2 control technologies, however, EPRI recognized that the subject of management of solid wastes from the new control technologies had not been examined in depth. The purpose of this paper is to provide a description of the research EPRI is conducting with regard to management of the solid waste materials from these new SO_2 control technologies. A discussion of the preliminary results of the research project also is presented. The research project focuses on spray drying, atmospheric fluidized bed combustion, limestone furnace addition, dry sodium addition, and advanced physical coal cleaning. Within the project are activities dealing with information surveys and assessments, waste characterization, leachate testing, conceptual designs, case studies, and utilization options. The project is comprehensive in scope and will be providing topical reports on various activities during the next three years. 14 references, 1 figure, 8 tables.

33616 (EPRI-CS—4390-Vol.2, pp 10.111-10.131) **Thermal oxidation of spray dryer FGD waste product.** Bengtsson, S.; Ahman, S.; Lillestolen, T.; Koudijs, G. (Flakt Industrial, AB, Sweden). Jan 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920170. (CONF-850630—Vol.2).

From 9. symposium on flue gas desulfurization; Cincinnati, OH, USA (4 Jun 1985).

Spray dryer FGD for coal fired boilers using low and medium sulfur coals has become an important technology. Typically, the FGD end product has been disposed of, untreated, in landfill areas. In some countries in Europe, disposal by these means is not permitted. These countries require that the FGD end product be reclaimed for alternate use. To meet this requirement, Flakt entered into a cooperative agreement with Dorr-Oliver to develop a thermal oxidation system based upon the Dorr-Oliver FluoSolids Technology. This system provides for the calcination of the Dry FGD end product to produce a technical grade anhydrous calcium sulfate, which can be used as a setting retarder for Portland Cement. This paper describes the process and presents operating experience and test results from a pilot plant program, and a demonstration plant (2.5 metric ton/hour) test program. Further, a description is included on how this process has been integrated into a commercial Spray Dryer FGD System. 4 references, 11 figures.

33617 (EPRI-CS—4390-Vol.2, pp 11.1-11.20) **Reliability problems and solutions of FGD systems.** Agarwal, D.C. (Cabot Corp., Kokomo, IN). Jan 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920170. (CONF-850630—Vol.2).

From 9. symposium on flue gas desulfurization; Cincinnati, OH, USA (4 Jun 1985).

At a first glance, operation of a typical limestone FGD system seems deceptively simple. However, the first generation scrubbers of the early to mid 70's proved to be a financial and operational disaster due to metals corroding in a short time and nonmetals failing by blistering, debonding, flaking and peeling. Various solutions were tried with only partial success. An extensive research program to find better materials of construction which would provide the necessary reliability in a cost effective manner, led to higher alloys up the ladder of increasing Ni-Cr-Mo alloy family and new non-metallic coatings. These also proved unreliable in many cases, resulting in unscheduled shut downs, soaring maintenance costs, lost revenues and the penalties imposed from buying power from the grid, while these systems were being patched up. In the present period of the 80's, the alloy with the highest molybdenum content of the Ni-Cr-Mo family has not only provided the necessary reliability in performance but has done so in a cost effective manner via the use of a concept known as wallpaper concept. In this method a 1/16-inch veneer of alloy C-276 is welded onto the carbon steel or lower alloy structure. Economic analysis shows this method to provide the lowest annual cost over the design life of the plant. Case histories will be shown where this method has provided maintenance-free service for over four years and the alloy sheets still look the same as when originally installed, indicating many more years to continued reliable service. 14 references, 9 figures, 6 tables.

33618 (EPRI-CS—4390-Vol.2, pp 11.21-11.32) **Four Corners 4 and 5 waste processing system: an integrated and unique retrofit.** Simko, A.P.; Lunt, R.R.; White, C.S. (Arizona Public Service Co., Phoenix). Jan 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920170. (CONF-850630—Vol.2).

From 9. symposium on flue gas desulfurization; Cincinnati, OH, USA (4 Jun 1985).

The Arizona Public Service Company has retrofit Particulate and Sulfur Dioxide Control Systems to Units 4 and 5 of its Four Corners Steam Electric Generating Station. As part of the SO_2 control system, APS installed a Conversion Systems, Inc. Waste Processing System to process the fly ash and FGD sludge. This System is unique in that it is: the latest operating retrofit in the US; the largest retrofit (1600 MW) in the US; a specially designed vertical layout waste processing plant for direct loading of trucks; designed for five modes of waste processing; designed to be operated on an intermittent basis; and designed to work with, rather than replace the existing fly ash handling system. 5 figures, 2 tables.

33619 (EPRI-CS—4390-Vol.2, pp 11.33-11.43) **Corrosion resistance comparison of duplex stainless steel with type 317LM in simulated flue gas scrubber environments.** Van Hoose, R.E.; Guernsey, J.B. (Eastern Stainless Steel Co., Baltimore, MD). Jan 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920170. (CONF-850630—Vol.2).

From 9. symposium on flue gas desulfurization; Cincinnati, OH, USA (4 Jun 1985).

Type 317LM austenitic stainless steel (modified 317L containing 4% minimum molybdenum) is probably the most widely used high alloy material for construction of Flue Gas Desulfurization (F.G.D.) equipment. This is because its corrosion resistance is well suited to handle the corrosive environment produced by F.G.D. systems, with cost far lower than for other suitable alloys. The work discussed here indicates that the austenitic-ferrite duplex stainless steel type 2205 may be equal in corrosion resistance and superior in other regards to type 317LM in F.G.D. applications. The corrosion resistance of type 2205 and type 317LM were compared in simulated F.G.D. environments to evaluate type 2205 as a construction material for F.G.D. systems. Crevice corrosion, pitting corrosion and general corrosion tests were performed on both types in several different solutions consisting of high chloride concentrations (Na and Ca base), with varying pH levels and high temperatures. Tests to determine critical pitting temperatures of both alloys were also conducted. The results of these tests indicate that the corrosion resistance of type 2205 is comparable to that of 317LM. The significantly higher strength of type 2205, lower alloy costs and comparable corrosion resistance to simulated F.G.D. environments make it a very good candidate for F.G.D. construction material. 3 references, 3 figures, 4 tables.

33620 (EPRI-CS—4390-Vol.2, pp 11.59-11.78) **Chemistry of sodium dry sorbent injection.** Mueller, A.W.; Winston, A.E. (Church & Dwight Co., Inc., Piscataway, NJ). Jan 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920170. (CONF-850630—Vol.2).

From 9. symposium on flue gas desulfurization; Cincinnati, OH, USA (4 Jun 1985).

The purpose of this paper is to examine the mechanisms involved in the gas-solid reaction of sodium bicarbonate with SO_2 and thereby explain why bicarb stands out as the preferred dry sorbent. A possible explanation of the sodium bicarbonate reaction mechanism is that the heat provided by the flue gas stream causes the thermal decomposition of sodium bicarbonate into sodium carbonate in a manner to effect optimum reaction conditions with the sulfur dioxide portion of the flue gas stream. The thermal decomposition of sodium bicarbonate over a specified temperature range is best described by a shrinking core model with chemical reaction as the rate controlling step. As the sodium bicarbonate core decomposes, new surfaces continually become available for reaction with sulfur dioxide. The decomposition of sodium bicarbonate may also provide a moisture layer which serves as a reaction medium and thereby increases the neutralization rate. The resultant layer of sodium sulfate remains permeable so as to have no effect on reaction rate. Data will be examined which lends support to this theory and illustrates the relationship between temperature, particle size and surface area relative to dry sorbent performance. 4 references, 10 figures, 4 tables.

33621 (EPRI-CS—4390-Vol.2, pp 11.79-11.89) **Techno-economic investigation into the hybrid technology of FGD and PCC applied to large boilers of firing Canadian coals.** Wang, R.L. Jan 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920170. (CONF-850630—Vol.2).

From 9. symposium on flue gas desulfurization; Cincinnati, OH, USA (4 Jun 1985).

Under the policy of energy self-sufficiency in Canada, the federal government has encouraged large boiler users to fully utilize indigenous coals as a primary fuel source for steam generation. At the same time, the public awareness of adverse impacts of acid rain on the northern environment will lead the present SO_2 emission control guideline to be further stringent. Utility users, engineering designers, science investigators and others are paying their attention to the study of operationally reliable and cost saving measures for removal of sulfur compounds anterior and posterior to combustion (in some cases even dealing with in-suit capture in a combustion region). This paper examines coal properties of major Canadian reserves required for utility/industrial steam generation. Main commercialized technologies of FGD (Flue Gas Desulfurization) and PCC (Physical Coal Cleaning) are reviewed. Their cost accounts based on individual and hybrid systems are estimated. Results of cost benefit analysis on capital investments, annual operating/maintenance cost and equivalent unit revenue requirement in life cycle operation are presented. 5 references, 6 figures.

33622 (EPRI-CS—4390-Vol.2, pp 11.107-11.134) **NOXSO process development: an update.** Haslbeck, J.L.; Neal, L.G. (NOXSO Corp., Library, PA). Jan 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920170. (CONF-850630—Vol.2).

From 9. symposium on flue gas desulfurization; Cincinnati, OH, USA (4 Jun 1985).

The NOXSO process is a dry, regenerable flue gas treatment system that reduces emissions of SO_2 and NO/sub x/ from coal-fired boilers by 90%. In 1982, NOXSO Corporation initiated a research and development program designed to develop the process for the commercial market. This paper covers the work accomplished in the last six months. It is an update of two previous

papers published in 1983 and 1984. The paper presents the results of research in the areas of process chemistry, sorbent performance, materials of construction and process design and economics. 17 references, 6 figures, 8 tables.

33623 (EPRI-CS—4390-Vol.2, pp vp) **By-product gypsum production at a 2300 MW power plant.** Mzyk, D.; Zmuda, J. (Texas Utilities Generating Co., Tatum). Jan 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920170. (CONF-850630—Vol.2).

From 9. symposium on flue gas desulfurization; Cincinnati, OH, USA (4 Jun 1985).

The Martin Lake Station of Texas Utilities consists of three 770 MW boilers firing lignite coal. Each boiler is equipped with a Research-Cottrell limestone flue gas desulfurization (FGD) system. The FGD systems were originally designed to produce a sulfite sludge to be blended with fly ash for disposal. In early 1983 each FGD system was retrofitted with equipment for in-situ oxidation to produce a calcium sulfate (gypsum) by-product. Startup and testing of the forced oxidation system are discussed. Utility operating experience, which led to the signing of a contract for the scale of commercial grade gypsum for wallboard manufacture, will also be discussed. 5 figures, 3 tables.

33624 (PB—86-160041/XAB) **Evaluation of a bench-scale dry-flue-gas desulfurization system for screening potential reagents and operating conditions.** Rohlack, L.A.; Blythe, G.M.; Brna, T.G.; Rhudy, R.G. (Radian Corp., Austin, TX (USA)). Feb 1986. 29p. NTIS, PC A03/MF A01.

The paper discusses two series of bench-scale dry-flue-gas desulfurization (FGD) laboratory tests, the primary objective of which was to evaluate the ability of a bench-scale dry-FGD system to screen potential reagents and operating conditions in support of testing at larger pilot-plant or full-scale systems. The first series consisted of once-through and recycle tests with hydrated-lime reagent using a laboratory spray dryer/fabric filter system rated at 0.024 cu m/s. These tests duplicated conditions in similar tests with the 2.5-MW spray-dryer/fabric filter pilot plant at the EPRI Arapahoe Test Facility. In the second series, the bench-scale spray-dryer/fabric-filter system was modified to permit the dry injection of reagents upstream of the baghouse. The series was designed to simulate dry-sorbent injection. Several sodium bicarbonate reagents and a calcium-based reagent were tested. Test results and the feasibility of using the bench-scale system for screening sorbents and operating conditions are discussed.

33625 (PB—86-161304/XAB) **Economic evaluation of oil agglomeration for recovery of fine coal refuse. Final report, January 1982-February 1985.** Larkin, L.; Maxwell, J.D. (Tennessee Valley Authority, Muscle Shoals, AL (USA). Div. of Energy Demonstrations and Technology). Aug 1985. 71p. NTIS, PC A04/MF A01.

The report gives results of an evaluation of the economics of an oil-agglomeration process (with and without an oil recovery system) for recovering coal fines from a fine refuse stream of 105 ton/hr from a coal preparation plant. The two base case processes studied are oil-agglomeration processes: in one, heptane is used and recovered; and in the other, fuel oil is used and blended with the product. The economics for both processes were estimated with and without a pond credit (savings in coal preparation plant investment resulting from the smaller waste disposal pond needed for the oil-agglomeration process).

0109 Environmental Aspects

REFER ALSO TO CITATION(S) 33519, 33553, 34164, 34777

33626 (LMF—114, pp 61-66) **Emissions from atmospheric pressure fluidized bed coal combustion and pulverized coal combustion.** Newton, G.J.; Yeh, H.C.; Carpenter, R.L.; Hanson, R.L. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

The authors have been collecting process stream samples of flue gas aerosols from operating atmospheric pressure fluidized bed coal combustors (AFBCs) for several years. The purpose of this report is to summarize the data for these field sampling efforts and compare the data with similar data published by other investigators on conventional pulverized coal combustion (PCC). The results and comparisons indicate that AFBCs emit less fly ash than do PCCs but probably emit more vapor-phase hydrocarbons than do PCCs. 3 references, 2 figures, 4 tables.

33627 (PB—86-151842/XAB) **Fracture-zone dewatering to control ground water inflow in underground coal mines. Report of Investigations/1985.** Schmidt, R.D. (Bureau of Mines, Twin Cities, MN (USA). Twin Cities Research Center). 1985. 91p. (BM-RI—8981). NTIS, PC A05/MF A01.

The Bureau of Mines investigation focuses on the identification and control of ground-water inflow problems that occur in the active sections of underground Appalachian coal mines. A fracture inflow survey of eight underground mines was conducted. Three types of mine fracture intercepts were identified, which are typical of wet section mining conditions. A mine in Preston County, WV was selected as the site for a fracture-zone dewatering experiment. Fracture trace analysis was used to site dewatering wells in a fracture valley setting ahead of mine development. The design, implementation, and results of the dewatering experiment are presented. The investigation suggests that fracture zones are responsible for the sudden release of stored ground water, which often occurs as mining sections advance beneath fracture valley topography. It is concluded, therefore, that dewatering operations that are designed to intercept the component of ground water that is stored in fracture zones will be most effective in controlling infiltration to active mine sections.

33628 (PB—86-155793/XAB) **Literature on the revegetation of coal-mined lands: an annotated bibliography. Information Circular/1985.** Veith, D.L.; Bickel, K.L.; Hopper, R.W.E.; Norland, M.R. (Bureau of Mines, Twin Cities, MN (USA). Twin Cities Research Center). 1985. 303p. (BM-IC—9048). NTIS, PC A14/MF A01.

Bureau of Mines bibliography of U.S. and Canadian literature pertaining to revegetating coal-mined lands contains 805 references published from 1977 to 1984. Each reference is evaluated by keywords, providing the reader with a means of rapidly sorting through the references to locate only those dealing with the coal mining region and subject of interest.

33629 (PB—86-158433/XAB) **Characterization of volatile sulfur compounds produced from Illinois coal chars. Environmental geology notes.** Chou, M.M.; Griffin, R.A. (Illinois State Geological Survey, Champaign (USA)). 1985. 20p. (IL/SGS/ENG—113). NTIS, PC A02/MF A01.

In the study the authors characterized the major volatile sulfur compounds produced during pyrolysis of chars under different atmospheres and temperatures. To investigate the effects of pyrolysis atmosphere on th evolution of volatile sulfur compounds, an acid-leached char made from high-sulfur Illinois coal was pyrolyzed at 800 C in a hydrogen and in a nitrogen atmosphere. Study results indicate that elemental sulfur was produced during hydrochloric acid leaching and suggest that the improved rate of sulfur removal observed when char was acid-leached before hydropyrolysis is probably partly due to the conversion of strongly bound mineral sulfur forms to elemental sulfur or weakly bound sulfur forms that can be more easily removed by hydrogen during subsequent hydropyrolysis. The chemical reaction with hydrogen, in addition to heat, was necessary to prevent the elemental sulfur produced during acid leaching and retained in the char from becoming refixed into the char matrix during pyrolysis. Information provided by the study on the retention of sulfur in char and the reactions involved in its removal may have important implications for the development of coal-desulfurization processes using a low-sulfur char made from high-sulfur coal.

0110 Reserves And Exploration

REFER ALSO TO CITATION(S) 33560, 33651

0120 Mining

REFER ALSO TO CITATION(S) 33654

33630 **(PB—86-151818/XAB) Computer program to relate dust generation to drum-type coal-mining machines. Report of Investigations/1985.** Roepke, W.W.; Hanson, B.D.; Schmidt, R.L. (Bureau of Mines, Twin Cities, MN (USA). Twin Cities Research Center). 1985. 37p. (BM-RI—8979). NTIS, PC A03/MF A01.

The Bureau of Mines has developed an interactive computer program that enables mine operators and others to identify the effect of cutting system changes on relative dustiness at the face. The program, which simultaneously evaluates machine parameters, coal seam parameters, and operator-controllable parameters, was developed for use on any microcomputer using BASIC programming language. The program allows the user to change one or more of the cutting system parameters at a time to see how these changes affect relative dustiness. A complete program listing and flowchart are included along with operating instructions and sample outputs. An example showing how to use the program is also included.

33631 **(PB—86-155975/XAB) Conical-bit rotation as a function of selected cutting parameters. Report of Investigations/1985.** Wingquist, C.F.; Hanson, B.D.; Roepke, W.W.; Myren, T.A. (Bureau of Mines, Twin Cities, MN (USA). Twin Cities Research Center). 1985. 26p. (BM-RI—8983). NTIS, PC A03/MF A01.

The Bureau of Mines is engaged in research to evaluate the effects of cutter-bit wear at coal-mine faces. The paper addresses one element of conical-bit wear, bit rotation. A discussion on mounting configuration and bit forces and their effects on rotation is presented. The effects on rotation and bit forces of bit attack angle, cutting depth, and skew are determined for two types of conical bits during linear cutting of sandstone-inclusive rock.

33632 **(PB—86-156171/XAB) Effects of water on coal-cutting forces and primary-dust distribution. Report of Investigations/1985.** Roepke, W.W.; Myren, T.A. (Bureau of Mines, Twin Cities, MN (USA). Twin Cities Research Center). 1985. 21p. (BM-RI—8993). NTIS, PC A02/MF A01.

Research to evaluate the lubricity effects achieved by spraying water on the cutting bit of a mining machine or spraying water on the coal during cutting has shown that neither practice affects cutting forces, as has been believed. However, when water was supplied to the cutting zone axially through the bit at 3,000 to 5,000 psi pressure, tangential cutting forces were reduced an average of 30 pct at a 1-in depth of cut while normal bit forces were reduced an average of 65 pct. Lower normal forces mean reduced bit wear, faster advance with greater depth of cut, and fewer coal fines.

0130 Transport And Handling

REFER ALSO TO CITATION(S) 33523, 33557, 33644

33633 **(DOE/EV/10244—T6) Field flow fractionation in the analysis of energy related materials. Progress report, February 1, 1983-January 31, 1984.** Giddings, J.C. (Utah Univ., Salt Lake City (USA). Dept. of Chemistry). Nov 1983. Contract AC02-79EV10244. 10p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86010587.

Advances have been made on a number of fronts that will help implement the application of field-flow fractionation (FFF) to particle characterization. Our research activities have followed the general course outlined in the research plan. However, in the course of this research, we have found it necessary in several instances to focus on some very basic kinds of measurements in order that the ultimate FFF results will be more accurate. Channel void volume and channel flow rate are two parameters that underly FFF particle characterization work for which accurate measurement methods do not exist. We have expended considerable effort on these two fundamental problems.

33634 **(DOE/MC/20700—2056) Chemical coal cleaning process and costs refinement for coal-water slurry manufacture.** Bhasin, A.K.; Berggren, M.H.; Ronzio, N.J.; Smit, F.J. (AMAX Extractive Research and Development Center, Golden, CO (USA)). 31 Dec 1985. Contract AC21-83MC20700. 146p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE86010793.

This report describes the results of process and cost refinement studies for the manufacture of ultra-clean coal-slurry fuel for direct-fired gas turbines. The work was performed as an extension to an earlier contract in which AMAX R & D supplied METC with two lots of highly beneficiated coal slurry fuel for use in the Heat Engines program. A conceptual design study and cost estimate supplied to METC at that time indicated that a combined physical and chemical cleaning process could produce ultra-clean fuel at a competitive price. Laboratory and pilot plant studies performed for the contract extension further defined the process conditions and operating and capital costs to prepare coals containing from 0.2 to 1.0% ash as slurry fuels. A base-case fuel containing coal cleaned to 0.5% ash in a 1000 cp slurry containing 55% coal was $4.16 per million Btu when produced in quantities required to fuel a 500 MW gas-turbine generating station. Coal slurry fuel production costs as low as $3.66 per million Btu were projected for coals cleaned to 1.0% ash. 12 refs., 23 figs., 63 tabs.

33635 **(DOE/PC/72007—T9) Ultra-fine coal characterization. 8th quarterly report, December 1, 1985-February 28, 1986.** Smit, F.J. (AMAX Extractive Research and Development Center, Golden, CO (USA)). 10 Apr 1986. Contract AC22-84PC72007. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86010744.

Research continued to relate the beneficiation characteristics of ultra-fine coal to the mineral-matter liberation and the bulk properties of the coal. Washability tests were made on washed coals from the Pittsburgh, Upper Freeport and Pocahontas No. 3 seams following procedures established for midwestern coals. An initial set of flotation modelling experiments on Illinois No. 6 coal were completed and evaluated. Zeta-potential measurements were also made on particles of 5 coals suspended in water of pH 2 to pH 12. 3 refs., 8 figs., 9 tabs.

33636 **(DOE/PC/80514—03) Chemistry and reactivity of micronized coals. Technical progress report No. 3.** Lloyd, W.G.; Riley, J.T.; Kuehn, K.W. (Western Kentucky Univ., Bowling Green (USA). Ogden Coll. of Science, Technology and Health). 15 May 1986. Contract FG22-85PC80514. 42p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86010673.

This project examines the effect of reduction of the mean particle size of bituminous coals (to less than 10 microns) upon the coals' physical and chemical properties. The second part of a survey of the Hardgrove Grindability Index (HGI) is presented. Forty-two coals from the WKU/DOT base, for which HGI data have been obtained, were examined petrographically. Regression analyses show little correlation with HGI. The ambient apparent viscosities of four aqueous slurries of micronized coals are found to show sharply pseudoplastic character. Over the range of shear rates studied, all four show good power law conformity. Slurry attrition is very fast down to mean sizes of the order of 10 microns, then much slower in approaching the 2 to 4 micron range. A micronized high-ash coal shows anomalously strong retention of moisture and (from extractions) of dimethylformamide, both polar solvents. Classification of pulverized coals by size fraction continues to show sharp variations in mineral matter distribution. Our best preliminary demineralizations are attained with lightly milled coals. Optimal deep cleaning may involve alternate cycles of milling and separation steps. At 350°C a 20-minute hydroliquefaction of a hvBb coal affords the expected low conversion (7% daf by toluene). Parallel runs with the micronized coal essentially double this conversion. 15 refs., 12 figs., 10 tabs.

33637 (DOE/PC/80525—T3) Three-dimensional structure of flow in coal-cleaning cyclones. Technical progress report No. 3, March 1-May 31, 1986. Hwang, C.C.; Chiu, C.L. (Pittsburgh Univ., PA (USA)). 1986. Contract FG22-85PC80525. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86011488.

In this quarter the mathematical modeling and simulation of the three dimensional flow of water in a hydrocyclone under assumed designs actually began. The following factors and components are included and combined in the modeling and simulation: (1) geometrical dimensions of hydrocyclones; (2) operational variables such as the input flow rates and pressure values at the inlet and outlets; (3) empirical and semi-empirical results and findings reported in the existing literature, about the values and distributions of tangential component of flow velocity which is related to the radial distribution of pressure in a cross section; (4) empirical modeling of the distribution of the longitudinal component of flow velocity, using the input discharge, boundary values of the velocity, pressure differential between the two outlets, and empirical form of velocity distribution reported in literature; (5) semi-empirical shear stress distribution based on the distribution of longitudinal velocity component, and boundary values of shear stress and its gradient in the radial direction; (6) momentum equation in the coordinate system formed by the circular isovels of the longitudinal flow component and their (radial) orthogonal trajectories, which relates the radial component of flow velocity to the longitudinal pressure gradient, shear stress and shear stress gradient in the radial direction, and gradient of longitudinal velocity component in the radial direction. The modeling and simulation technique being developed is, therefore, semi-empirical with building blocks consisting of analytical, empirical, and semi-empirical results from the present and past research.

33638 (IS-M—558) Effect of alkaline leaching conditions on coal mineral matter. Fan, C.W.; Markuszewski, R.; Wheelock, T.D. (Iowa State Univ. of Science and Technology, Ames (USA)). 1985. Contract W-7405-ENG-82. 4p. (CONF-851003—19). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011431.

From Conference on coal science; Sydney, Australia (28 Oct 1985).

The fate of the mineral matter was observed when coal was leached with hot alkaline solutions. The principal solid conversion product of pyrite was hematite but under some conditions small amounts of magnetite and pyrrhotite were formed. The clay minerals were converted to various sodium hydroaluminosilicates, and the quartz was extracted. However, under some conditions amorphous silica was precipitated when the leachant was cooled. 7 refs., 3 tabs.

33639 (MINTEK-M—238) Beneficiation of fine coal. Dawson, M.F. (Council for Mineral Technology, Randburg (South Africa)). 10 Jan 1986. 32p. NTIS (US Sales Only), PC A03/MF A01. File Number DE86901419.

Laboratory flotation tests were carried out on samples of coal fines from three South African collieries. The results indicated that improved efficiency in terms of plant capacity and reagent consumption could be obtained by an increase in the solids content of the slurry and closer control of the sizing of the solids. It was shown that, even on closely sized feed, flotation did not yield a product of truly low ash content, and that this was due to the biomedal nature of the size distribution of the mineral matter in the coal. The mineral matter was present as 'sand', mainly greater than 75 μm, and as 'silt' mainly less than 10 μm. Flotation proved to be selective only for coal particles containing sand. Separation with heavy liquid showed that coal particles with ash contents of 3 to 7% could be separated with good yield. Since this material showed almost no difference in flotation response from that of particles with a much higher silt content, the result was an overall best flotation grade of about 10% ash. Calculations of the density of the ash-free coal showed that this increased from about 1,25 g/cm^3 for particles with an ash content of 3% to about 1,36 g/cm^3 for particles with an ash content of 20%. Maceral analysis would be of interest in this respect. 3 refs., 9 figs., 25 tabs.

33640 (PB—86-159464/XAB) Study of design and development of a coal injector for coarse slurry transport. Open File report. Wise, B.; Bell, S.; Thompson, D. (Ingersoll-Rand Research, Inc., Princeton, NJ (USA)). May 1985. 359p. NTIS, PC A16/MF A01.

A jet pump injector was developed and successfully tested, thereby demonstrating the feasibility of a jet injector for introducing coarse coal into an operating slurry face haulage system.

0140 Combustion

REFER ALSO TO CITATION(S) 33948, 33949, 34259, 34575, 34604

33641 (DOE/ET/10393—1856) Performance of high and medium temperature valves. (NCB (IEA Grimethorpe) Ltd., Grimethorpe, Barnsley, South Yorkshire (UK)). Jun 1985. Contract AI01-76ET10393. 93p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85008598.

The Experimental Pressurized Fluidized Bed Combustion Facility at Grimethorpe, South Yorkshire, UK utilizes a number of valves operating at high temperature and pressure up to 12 bar and 950°C with varying degrees of entrained dust in the transport fluid. Although not a defined objective, testing of different valve designs was necessary. The valves used are classed into three groups, six manufacturers being selected. The report covers the operational experience established between March 1982 and March 1984. During this period the Facility was operated for a total of 2741 coal burning hours. The major problems with the valves were valve leakage and sticking. The sticking problem was minimized by heating the valves, decreasing seat pressure and increasing actuator torque. Modifications to prevent leakage have included modifications to valve seats and supports, new support materials, new spring materials and regular maintenance. 5 refs., 28 figs., 4 tabs.

33642 (DOE/FE/60181—178) Enhanced utilization of furnace injected calcium-based sorbents. Weber, G.F.; Collings, M.E.; Bobman, M.H. (North Dakota Univ., Grand Forks (USA). Energy Research Center). 1986. Contract FC21-83FE60181. 17p. (CONF-860634—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86010901.

From Joint symposium on dry SO/sub 2/ and simultaneous SO/sub 2//NO/sub x/ control technologies; Raleigh, NC, USA (2 Jun 1986).

Simultaneous control of SO/sub x//NO/sub x/ emissions is under investigation at the University of North Dakota Energy Research Center (UNDERC). Furnace injection tests have focused on the direct injection of pressure-hydrated lime followed by particulate collection in a baghouse operated at temperatures of 63° to 149°C (145° to 300°F). Sulfur dioxide reduction as high as 80% has been observed for high-calcium pressure-hydrated lime (PHL) injected at a Ca/SO_2 mole ratio of 2.0 with all of the SO_2 capture occurring in the flue gas at temperatures exceeding 760°C (1400°F). Pilot-scale tests have shown that furnace injection of high-calcium PHL at a Ca/SO_2 ratio of 1.0 can result in 65% to 70% SO_2 capture if the baghouse is operated at 71°C (160°F), approximately 11°C (20°F) above the dew point. Improved sorbent utilization has been observed both for high-calcium PHL and for additive enhanced high-calcium PHL at baghouse temperatures of 63° to 104°C (145° to 220°F). Of the 65% to 70% overall utilization, 45% to 50% of the sorbent was utilized in the upstream flue gas and an additional 15% to 25% in the baghouse. 12 refs., 7 figs., 4 tabs.

33643 (DOE/FE/60181—205) Combustion of Beulah lignite char in a single-particle combustor. Young, B.C.; McCollor, D.P.; Weber, B.J.; Jones, M.L.; Grow, D.T. (North Dakota Univ., Grand Forks (USA)). Mar 1986. Contract FC21-83FE60181. 11p. (CONF-8604144—6). NTIS, PC A02/MF A01; GPO Dep. File Number DE86010761.

From Spring meeting of the Western States Section of the Combustion Institute; Alberta, Canada (28 Apr 1986).

A single-particle reactor has been constructed and used to investigate the combustion kinetics of char particles. The temperature of the burning particles is measured with a three-color pyrometer and from the measurements rate data is evaluated. Preliminary

rate data have been obtained on chars prepared from Beulah lignite under different atmospheres. The burning rates of these chars were controlled by the mass transfer of oxygen to the particle surface. The high chi values, indicating the predominance of mass transfer control of the burning rate, reflect the high reactivity of the Beulah lignite chars. Pyrolysis temperature and heating rate both affect char reactivity, relatively low pyrolysis temperature and fast heating rate leading to a highly reactive char. In addition, the reactivity will also be affected by the chemical constitution of the char. In the case of lignite chars, mineral matter should exert a strong influence on reactivity. Further work is being undertaken on chars from Beulah lignite and other coals and prepared under inert and oxidizing atmospheres. 17 refs., 4 figs., 2 tabs.

33644 **(DOE/MC/20404—2059) Micro-coal pyrolysis and heat engine applications. Final technical report.** Freihaut, J.D. (United Technologies Research Center, East Hartford, CT (USA)). Jan 1986. Contract AC21-83MC20404. 91p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86006967.

The objectives of this investigation were: (1) to establish a fuel characterization technique to assess the effects of beneficiation - physical and chemical - and slurry processing on coal composition and combustion behavior; (2) to establish a data base containing coal structure characteristics and combustion behavior; (3) to develop a phenomenological understanding of coal pyrolysis in high intensity heating conditions. In this investigation, parent, beneficiated and slurried coal samples were obtained from three commercial manufacturers of micronized coal water slurries. Two additional slurry samples were obtained from different process runs made by two of the manufacturers. In addition, four, dry and beneficiated samples were obtained from other manufacturers of "heat engine quality" coal feeds. Structural characteristics and rapid-heating pyrolysis behavior of beneficiated samples obtained from different manufacturers varied appreciably, despite the fact that most of the processes started with similar hvBit coal feeds. Investigations of dried samples of the slurry feeds indicate that dispersants and stabilizers employed in the slurry processing can significantly affect gross structural characteristics of the slurried particles and their combustion related pyrolysis behavior. Results are presented and an understanding of pyrolysis behavior in conditions similar to high intensity combustion conditions is developed. Pyrolysis behavior or micronized samples of a range of coal ranks is also presented to clarify the behavior of the micronized samples derived from hvBit coals and in anticipation of extending the types of coals that are utilized in heat engines. The results and model are presented in the context of a larger data base and understanding of coal devolatilization developed in previous investigations. 71 refs., 37 figs., 23 tabs.

33645 **(DOE/MC/21194—T2) Component evaluation and system performance in a PFB facility. Quarterly technical progress report, January 1-March 31, 1985.** (New York Univ., Westbury, NY (USA). Antonio Ferri Labs.). 1985. Contract AC21-84MC21194. 41p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86011410.

The progress on the various subtasks, aimed at modifying the existing PFB facility to evaluate components and enhance operation flexibility and data collection, is on schedule. The components of the variable back pressure system have been manufactured. A new horizontal heat exchanger was manufactured, and four new test specimen materials were included in this heat exchanger to study the metal wastage phenomena. All four heat exchangers were placed in position within the combustor. The vertical heat exchanger designs is being reviewed by Babcock and Wilcox. Tension type load cells will be used for gravimetric coal feed measurements without any major modification of the support arrangement. Data acquisition programs are being developed on the real-time data processidng system. A modification to the exhaust system, contemplated under the present contract, has been considered. This activity aims at performance testing of three types of high temperature/high pressure filters. A budget proposal was submitted to DOE. Changes in the facility operating parameters are envisaged to meet filter test requirements, and major changes include 100 hour continuous runs of the facility. In the initial study phase of fluidized bed combustor scale up, design and performance parameters of the system have been identified. The design of an automatic bed temperature control system is in progress.

33646 **(DOE/MC/21351—2057) Analysis of metal wastage in coal-fired fluidized-bed combustors. Final report.** Nazemi, A.H.; Smith, E.P.; Madsen, M.M.; Malone, G.A.; Davis, R.D. (Mitre Corp., McLean, VA (USA)). Mar 1986. Contract AC21-84MC21351. 354p. NTIS, PC A16/MF A01; 1; GPO Dep. File Number DE86010237.

MITRE compiled metal loss data and relevant design/operating information for sixty-six alloys in twenty-nine FBC systems. After all of the data were assembled and reviewed, twelve alloys were selected for statistical analysis. Regression methodology was used to investigate the relationship between metal loss and design, operating, and performance parameters of FBC systems for a given alloy. Both inferential and exploratory methods were applied to analyze the data. Based on results of these analyses, the following general conclusions can be drawn: Exposure time, specimen temperature, bed temperature, and coal and sorbent compositions appear to be related to metal loss for most of the alloys, as indicated by the univariate analyses. With the exception of specimen temperature, a high degree of correlation is not reflected in individual variable plots (scatterplots). The regression analyses resulted in twelve models - one for each alloy. The diagnostic analyses of all twelve models indicate that the models are appropriate for the data. While the models differ in terms of the types of variables in them, there are a number of similarities. Based on the study results and data quality, MITRE concludes that a statistically-designed test program is needed before the effects of identified important variables (such as coal and sorbent compositions) can be confirmed and further quantified. 98 refs.

33647 **(DOE/PC/60424—T1) Combustion, heat transfer, ash deposition, and pollutant emission characteristics of coal-water slurries. Phase II. Final report, January 1, 1983-December 31, 1983.** Beer, J.M.; Farmayan, W.F.; Walsh, P.M.; Zhang, M.C.; Kolb, T.; Monroe, L.S.; Srinivasachar, S.; Teare, J.D.; DiTaranto, F. (Massachusetts Inst. of Tech., Cambridge (USA). Energy Lab.). Feb 1984. Contract FG22-83PC60424. 372p. NTIS, PC A06. File Number DE86010671.

Phase II of the MIT coal water slurry combustion research program has focused on several technical problem areas which were identified in Phase I as being the most critical in pertaining to the use of this fuel as oil substitute in industrial and utility boilers. These include: CWS ignition and flame stability, NO/sub x/ emission, carbon burnout, and ash deposition. Input variables examined in the Phase II experiments were: fuel type (Occidental Research Corp. and Atlantic Research Corp. standard and fine grind slurries); atomization quality as influenced by water content of the fuel (viscosity) and coal particle size distribution of the fuel; combustion air swirl degree (swirl number S = 0.68 to 2.8); combustion air staging (rich-lean combustion) (primary fuel-rich zone fuel equivalence ratio, phi/sub s/ = 1.2 to 1.7); oxygen co-injection with the fuel (equivalent enrichment of the combustion air 21 to 24%). The measurements carried out under Phase II included: still photographs and high speed cine films (5000 frames/sec) of the flame front; radiation traverses across the flame viewing hot (re-radiating) and cold (non-radiating) target; and the in-flame distributions of temperatures, axially directed velocities, stable gaseous species concentrations (O_2, CO_2, CO, NO/sub x/), solids concentrations, and solids carbon and ash content. In addition to a number of shorter experimental runs, three detailed mapping experiments were carried out for which data analysis is still continuing under Phase III, the third year of the program. These consist of Run 306, an unstaged high swirl flame obtained with the Occidental Research standard grind slurry, Run 308, a staged rich-lean flame obtained with the same fuel type as Run 306 and Run 309, a flame identical to Run 306 except for the fuel type, which in this case consisted of the Occidental Research fine grind slurry. 22 refs., 84 figs., 6 tabs.

33648 **(DOE/PC/80261—T4) Slagging retrofit pulsed combustor. Monthly progress report.** (Avco-Everett Research Lab., Everett, MA (USA)). May 1986. Contract AC22-85PC80261. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011102.

During the month of May we concentrated on achieving reproducible ignition of coal. We used small amounts of methane

(natural gas) coupled with the electric arc as the ignition source. As described in the last monthly report, methane was released from a 75 cc reservoir by actuation of a ball valve coupled to a 180° actuator. This setup resulted in a strong puff of methane directed at the arc gap. Repeated experimentation on ignition of methane alone revealed that, for the above setup, the relative time delay between the valve actuation and electric spark was very critical. For a given set of conditions (natural gas pressure in the 75 cc reservoir and helium pressure on the solenoid valve actuating the ball valve), the range of time delay over which we could obtain combustion of methane was less than half a millisecond. This small operating range made it extremely difficult to obtain reproducible ignition of methane. We attributed this effect to the short time and high velocity (sonic) at which methane exited the ball valve. We therefore replaced the 180° actuator with a 90° actuator. In this new setup the ball valve remains open after actuation, until it is manually shut off. We also introduced a gate valve downstream of the ball valve to permit control over the rate at which methane is injected in the combustor. With this new setup we have been able to achieve reproducible combustion of methane.

33649 (RISOE—304-44) Advance report on moving, pressurized fluidized-bed combustion. Stoholm, P.; Voldbro, V. (Forsoegsanlaeg Risoe, Roskilde (Denmark)). Jul 1985. vp. (In Danish). Forsoegsanlaeg Risoe, Roskilde, Denmark.

The technical, environmental and economic status of pressurized fluidized bed combustion is evaluated in this report, with emphasis on the utilisation of the technology in power stations and other large coal-consuming plants. The report is based on information from earlier development projects and those still in progress in the USA, UK, Sweden and FRG. These projects and related test activities are summarized in Appendix A.

0150 Marketing And Economics

REFER ALSO TO CITATION(S) 33513, 33692

33650 (GAO/RCED—86-109FS) Synthetic fuels. Status of the Great Plains Coal Gasification Project. (General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div.). Feb 1986. 22p. US General Accounting Office, Box 6015, Gaithersburg, MD 20877. File Number TI86901400.

This report includes updated information obtained through February 14, 1986, on the loan-default, Great Plains loan and gas pricing formula, legal matters and agreements, the Department of Energy's options and actions, and Great Plains operations. The new information highlights changes in the gas pricing calculations; legal action concerning gas purchase agreements and mortgage foreclosure; the Department's determination of the project sponsors' outstanding liability; the Department's progress in evaluating its options; revenue, expense, production, and plant employment data; capital improvement projects; and plant maintenance issues. Our November fact sheet included information on socioeconomic issues. We have not obtained any additional information on these issues and are, therefore, not repeating the socioeconomic information in this fact sheet.

33651 (PB—86-161684/XAB) Coal in New Zealand: resources, mining, use, infrastructure. Harris, G.S.; Suggate, R.P.; Sherwood, A.M.; Hooper, G.; Toynbee, P.A. (New Zealand Energy Research and Development Committee, Auckland). Oct 1985. 100p. (REPT—87). NTIS, PC A04/MF A01.

This final report is intended to provide background information for a systematic evaluation of the place of coal in the New Zealand energy scene, from coal in the ground, to its use and environmental and institutional aspects.

0160 Health And Safety

REFER ALSO TO CITATION(S) 33554, 33630, 33632

33652 (LMF—114, pp 316-321) Comparative lung immunotoxicity of inhaled quartz and coal combustion fly ash. Bice, D.E.; Hahn, F.F.; Benson, J.M.; Hobbs, C.H. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

The purpose of this study was to evaluate the effects of insoluble particles on the lung-associated lymph nodes (LALN) after lung immunization. F344/Crl rats were exposed for 4 wk to coal fly ash from a fluidized bed combustor (FBC) or a pulverized coal combustor (PCC). As a positive control, rats were similarly exposed to alpha quartz (Min-U-Sil). At 4, 40, and 52 wk after the start of the exposures, rats were immunized by intratracheal instillation of 10^8 sheep red blood cells, and immune responses evaluated. Exposure to fly ash and quartz increased the number of lymphoid cells in the LALN up to sixfold. At 52 wk, the number of antibody-forming cells in LALN from rats exposed to both PCC fly ash and quartz was significantly reduced. 6 references, 4 figures, 1 table.

33653 (MSHA/IR—1182) Injury experience in coal mining, 1984. (Mine Safety and Health Administration, Denver, CO (USA). Denver Technical Support Center). 1986. 386p. NTIS, PC A17/MF A01. File Number DE86901437.

This report reviews in detail the occupational injury and illness experience of coal mining in the United States for 1984. Data reported by operators of mining establishments concerning work injuries are summarized by work location, accident classification, part of body injured, nature of injury, occupation, and anthracite or bituminous coal. Related information on employment, worktime, and operating activity also is presented. Data reported by independent contractors performing certain work at mining locations are depicted separately in this report.

33654 (PB—86-153574/XAB) Advancement of cab and canopy design and use in coal mines. Open File report, February 1979-July 1981. Aljoe, W.W.; Whitehead, K.L. (BCR National Lab., Monroeville, PA (USA)). Aug 1981. 310p. (BCR-L—1206). NTIS, PC A14/MF A01.

The use of protective canopies can result in canopy roofing and/or serious restrictions to operator comfort and vision. To document this experience, a field study was conducted of cab and canopy design and application that resulted in a catalog of 164 canopy designs. An analysis of field data showed no simple relationship between working height and canopy-related problems. The relationship also involves (1) machine frame height, (2) mine floor undulations, (3) operator compartment dimensions, and (4) canopy design and location on the machine. Data analysis indicates (1) present technology does not always permit successful application of canopies in working heights below 42 inches and (2) development of satisfactory low-coal canopies is doubtful. The basic conclusion of the study is that future research and development studies should be directed at development of alternative protection systems and remote mining methods.

33655 (PNL-SA—13418) Chemical analysis and biological testing of catalytic-catalytic two-stage direct coal liquefaction process materials. Wright, C.W.; Chess, E.K.; Stewart, D.L.; Mahlum, D.D. (Pacific Northwest Labs., Richland, WA (USA)). Nov 1985. Contract AC06-76RL01830. 20p. (CONF-8511136—6). NTIS, PC A02/MF A01; GPO Dep. File Number DE86011116.

From Direct liquefaction contractors conference; Pittsburgh, PA, USA (19 Nov 1985).

The purpose of this paper is to highlight the results of the chemical analysis and biological testing of the pressure filter liquid (PFL) and product distillate brand (PDB) materials from the 25-day demonstration run of the CTSL process. Where applicable, the data from the analyses of the CTSL materials are compared to the results obtained from similar analyses of other two-stage coal lique-

faction processes. The comparative processes include the integrated two-stage liquefaction (ITSL) and the nonintegrated two-stage liquefaction (NTSL) processes. Chemical analyses were performed on fractions isolated from the PFL and PDB materials by adsorption column chromatography. Chemical class fractions of aliphatic hydrocarbons (AH), polycyclic aromatic hydrocarbons (PAH), nitrogen-containing polycyclic aromatic compounds (NPAC), and hydroxy-substituted PAH (hydroxy-PAH) were produced using neutral alumina as an adsorbent. Due to the high concentration of hydrogenated and partially hydrogenated components present in these samples, the hydroaromatic compounds were isolated using picric-acid-coated alumina as an adsorbent. Selected chemical fractions isolated from the PFL and PDB materials were then analyzed by high-resolution gas chromatography, gas chromatography/mass spectrometry, and low-voltage probe-inlet mass spectrometry. The biological activity of the CTSL materials was measured using two bioassays. The mutagenic response of all crude samples and chemical class fractions was measured using the histidine reversion microbial mutagenicity test with Salmonella typhimurium, TA98. Selected crudes were tested for tumorigenic potential using the initiation/promotion assay for tumorigenicity in mouse skin. 11 refs., 10 figs.

33658 **(PNL-SA—13676) Process related effects on the chemical and toxicologic characteristics of coal derived fuels.** Wright, C.W.; Chess, E.K.; Bean, R.M.; Mahlum, D.D.; Stewart, D.L.; Wilson, B.W. (Pacific Northwest Labs., Richland, WA (USA)). Jan 1986. Contract AC06-76RL01830. 12p. (CONF-860435—30). NTIS, PC A02/MF A01; GPO Dep. File Number DE86011134.

From Atomic and molecular physics conference; Aberdeen, Scotland (8 Apr 1986).

As a component of an ongoing program to assess the potential health effects of coal conversion materials, we have recently completed chemical and toxicologic studies of a sample set collected on selected days of a 25-day demonstration run of a catalytic two stage direct coal liquefaction (CTSL) process. There was an increase in heteroatomic, nitrogen containing polycyclic aromatic compounds (NPAC) and hydroxy-substituted PAC, compounds as the operation time of the pilot plant increased. The proportion of material which boiled above 975°F also increased in the solids-free portion of the recycle slurry oil as pilot plant operation time increased. As anticipated from the increase in NPAC concentration during the run, the microbial mutagenic activity of selected process materials also increased as a function of run time. Likewise, the tumorigenicity of the materials produced later in the demonstration run was higher than that of those produced initially. These results support the view that catalyst deactivation during the course of the run gives rise not only to lower coal conversion, but also to increased toxicologic activity. 9 refs., 3 figs., 3 tabs.

0170 Legislation And Regulations

REFER ALSO TO CITATION(S) 33650

02 PETROLEUM

0202 Geology And Exploration

33657 (CONF-850339—, pp 183-190) **Air emission sources and control technologies.** McGregor, C. (Minerals Management Service, Los Angeles, CA). Dec 1985. NTIS, PC A12/MF A01. File Number DE86007984.

From California offshore petroleum conference; Long Beach, CA, USA (26 Mar 1985).

The author identifies major sources of air emission, along with corresponding emission rates and appropriate control technology for offshore oil and gas activities. Major emission sources are found on exploratory drilling vessels and production platforms. The types of emissions of interest are oxides of nitrogen, gaseous hydrocarbons, and sulfur dioxide. Emissions are based on energy requirements or power demands and the appropriate emission factors for the relevant combustion engines. 6 figures, 8 tables.

33658 (CONF-850339—, pp 199-205) **Implications of/ and planning strategies for offshore oil development.** Venturini, P. (California Air Resources Board, Sacramento). Dec 1985. NTIS, PC A12/MF A01. File Number DE86007984.

From California offshore petroleum conference; Long Beach, CA, USA (26 Mar 1985).

The degeneration of air quality associated with the emissions of nitrogen oxides, hydrocarbons, sulfur oxides, and particulates as a result of offshore oil exploration and production is an item of widespread concern. As precursors to ozone, nitrogen oxides and hydrocarbons are of particular concern. The author describes the magnitude of these emissions and efforts to establish air quality standards and regulations that will protect public health. Planning improvements that will make air quality standards specific to California's needs and concerns require a continuing dialogue between industry and every level of government. 7 figures.

33659 (CONF-850339—, pp 219-226) **Seaport management choices and policy issues in offshore oil development.** Price, W. (Univ. of the Pacific, Stockton, CA). Dec 1985. NTIS, PC A12/MF A01. File Number DE86007984.

From California offshore petroleum conference; Long Beach, CA, USA (26 Mar 1985).

Offshore oil exploration and production presents an opportunity for seaports to respond to the demand for facilities and support services. The author's position is that the economic objectives of the private sector and the port enterprise are not the only reason for publicly owned ports. His proposal balances the roles of public port agencies and private oil companies, with the former exercising control through legislation, licenses, and leases. The public purpose is not to minimize offshore activity, but to direct attention to management of the environmental issues. Some public investment and risk is appropriate, given the likely benefit which will accrue to the community in proximity to offshore oil operations. This risk should be directly taken by seaport authorities, with secondary involvement of other planners and regulators. Private oil companies should take responsibility for facilities and the finding and handling of resources. 13 references, 2 figures.

33660 (CONF-850339—, pp 3-9) **Do we need offshore oil.** Brower, D. (Friends of the Earth, San Francisco, CA). Dec 1985. NTIS, PC A12/MF A01. File Number DE86007984.

From California offshore petroleum conference; Long Beach, CA, USA (26 Mar 1985).

Quoting from conservationists and naturalists to illustrate his point that, while we should produce offshore oil, we should hold back on our use of technology, the author argues that we have not yet proven the environmental safety of many of these technologies. A slower development pace might lower the environmental costs of energy development. Citing the dangers of acid rain and toxins and by-products of the petroleum industry, he challenges the need for financial incentives to accelerate exploration and production. A major investment in energy conservation would allow the emergence of a sustainable society that would price energy at its replacement cost and conserve resources for future generations.

33661 (CONF-850339—, pp 11-15) **Long range energy outlook.** Vaughan, W.A. (Dept. of Energy, Washington, DC). Dec 1985. NTIS, PC A12/MF A01. File Number DE86007984.

From California offshore petroleum conference; Long Beach, CA, USA (26 Mar 1985).

Diversification of supplies, efficiency, and the withdrawal of government interference in the marketplace have improved the US energy situation, but the most important factor is a fundamental change in our outlook for the future and the sense that we can regain control of our energy destiny. Energy policy today has replaced specific plans with a general statement of principles which emphasize the value of letting producers and consumers determine the best way to ensure adequate energy supplies at reasonable costs. DOE's preparation of the fifth version of the National Energy Policy Plan continues the strategies of minimum federal control and a balanced energy resource system. The success of this plan depends upon the development of offshore oil fields. The oil industry

must do a better job of convincing the public and its officials that this is a socially and economically valid policy.

33662 (CONF-850339—, pp 17-21) **Federal OCS.** Hallet, C. (Dept. of the Interior, Sacramento, CA). Dec 1985. NTIS, PC A12/MF A01. File Number DE86007984.

From California offshore petroleum conference; Long Beach, CA, USA (26 Mar 1985).

The Outer Continental Shelf (OCS) is one of the Interior Department's most controversial issues because of the misconceptions and range of perceptions surrounding the Outer Continental Shelf Lands Act. These misconceptions pertain to the amount of reserves, the need to develop new supplies, the cost of oil, environmental risks, and other matters. The author reviews some of the history of predictions and perceptions surrounding these issues. He notes that the US continues to be an oil importer, while the Soviet Union, Britain, and Canada are exporters. The risk of oil spills can never be eliminated, but has been significantly reduced. The draft plan for OCS development will increase leasing activity and reconfigure planning areas. Public consultations will increase in response to concerns that have been raised and in an effort to educate the public.

33663 (CONF-850339—, pp 53-55) **Federal OCS process.** Kallaur, C. (Minerals Management Service, Washington, DC). Dec 1985. NTIS, PC A12/MF A01. File Number DE86007984.

From California offshore petroleum conference; Long Beach, CA, USA (26 Mar 1985).

The author outlines the Department of the Interior's planning procedures in developing the five-year leasing program and individual sales. She describes the sequential decision process and the changing roles of local, state, and federal governments as a general plan emerges into a specific project. The importance of California's Outer Continental Shelf is evident in the nearly $40 billion the US spent last year to import oil. Both the pace and scope of offshore leasing have been controversial. Secretary Hodel has decided to lengthen the time between California offshore sales from a two-year to a three-year period, and to increase the planning areas from two to three regions. Another change will be focused, rather than area-wide lease sales. An unresolved issue is whether subareas within planning regions should get special attention. Planning for uncertainty requires provisions for accelerating procedures when conditions warrant.

33664 (CONF-850339—, pp 57-60) **State tidelands leasing process.** Dedrick, C.T. (California State Lands Commission, Sacramento). Dec 1985. NTIS, PC A12/MF A01. File Number DE86007984.

From California offshore petroleum conference; Long Beach, CA, USA (26 Mar 1985).

The State of California proposes leasing only an offshore area of under 200,000 acres which contain a conservative estimate of 800 million barrels of oil. California could receive a declining revenue of $500 million a year from leases, which makes them important to the state budget. The author contends that it is possible to develop these resources without destroying other natural resources, and that it is important for the state to keep pace with federal development of state lands. He describes the state leasing process, which requires an environmental impact review, as a net profits lease in which the state shares in the costs as well as the profits of developing any resource.

33665 (CONF-850339—, pp 61-63) **Role of coastal zone management.** Fischer, M. (California Coastal Commission, San Francisco). Dec 1985. NTIS, PC A12/MF A01. File Number DE86007984.

From California offshore petroleum conference; Long Beach, CA, USA (26 Mar 1985).

California's coastal zone is a unique subset environment subject to competition between conservationists and developers. In California, as in many of the 35 coastal states and territories, the coastal management agency is the only comprehensive planning and regulatory agency which can take into account the conflicts, giving priority to port and energy facility development while making sure that environmental resources are protected. State-federal partnership in protecting coastal regions requires that state officials, in trying to balance national interests, are really acting as federal agents. The author reviews the federal Coastal Zone Management Act and the importance of its reauthorization in this context. He sees efforts to cut funding as an attempt to convert it into an environmental act, which would make planning more confrontational.

33666 (CONF-850339—, pp 65-68) **Offshore permit process.** Ghylin, C.M. (Chevron U.S.A., Inc., Concord, CA). Dec 1985. NTIS, PC A12/MF A01. File Number DE86007984.

From California offshore petroleum conference; Long Beach, CA, USA (26 Mar 1985).

Successful bidders for offshore leases must meet state and local permit requirements as well as those of eight federal agencies. The author describes the leasing procedure from the perspective of a bidder, but focuses on the problem of the credibility of the environmental review process as it affects Chevron. Chevron's experience entails multiple copies of extensive paperwork, time delays, bureaucratic obstacles, and public hearings. By aggressively confronting all environmental issues, Chevron gained support for its project, only to have two lawsuits filed at the local level which appear to negate the money, time, and effort invested at the federal and state level.

33667 (CONF-850339—, pp 77-87) **California offshore exploration methods, status, and resource potential.** Redin, T. (Union Oil Co. of California, Ventura). Dec 1985. NTIS, PC A12/MF A01. File Number DE86007984.

From California offshore petroleum conference; Long Beach, CA, USA (26 Mar 1985).

The author describes the exploration methods commonly used when preparing for either a federal Outer Continental Shelf (OCS) lease sale or a state lease sale in California's offshore areas. He cites scuba diving as the simplest and least expensive way to obtain geologic data in water depths under 150 feet. The review covers common depth point reflection seismic surveying, prospecting, and exploratory drilling techniques for different stages of the lease sale preparation, and explains how assumptions, geologic pitfalls, and economics affect the estimation of resource potential. 12 references, 11 figures.

33668 (CONF-850339—, pp 89-94) **Developing oil and gas resources under the ocean.** Dozier, J. Jr. (Shell California Production, Inc., Bakersfield). Dec 1985. NTIS, PC A12/MF A01. File Number DE86007984.

From California offshore petroleum conference; Long Beach, CA, USA (26 Mar 1985).

There must be an incentive, a potential reward for learning how to do challenging things in order for industry and investors to develop offshore energy resources. The dominant drilling system for development wells and for separating the various components of raw production is the fixed-leg, bottom-supported platforms that have associated safety and environmental requirements. Future development in progressively deeper water and in unique and/or hostile environments will introduce new challenges. New types of compliant platforms, either the guyed-tower or the tension-leg design, offer promise. Subsea systems which operate on the sea floor and route production to either a fixed or floating platform are also under development. 6 references, 3 figures.

33669 (CONF-850339—, pp 123-125) **Public awareness of offshore petroleum activities.** Boyle, P. (Los Angeles Times, CA). Dec 1985. NTIS, PC A12/MF A01. File Number DE86007984.

From California offshore petroleum conference; Long Beach, CA, USA (26 Mar 1985).

Public confusion over when is the best time to develop offshore oil continues, with people living along the California and other beaches the most outspoken in their opposition. The issue requires more than education because the public also learns about the environmental risks as it becomes aware of the energy issues. Education that includes an understanding of these risks and tradeoffs will be more helpful than political or propaganda campaigns. More openness in the industry would also improve public perceptions. The oil companies, whose primary motive is to make a profit, need

to help the public understand the importance of that profit in the achievement of social goals.

33670 **Pattern recognition and tomography using crosswell acoustic data.** Albright, J.N.; Terry, D.A.; Bradley, C.R. (Los Alamos National Laboratory). pp 55-64 of 1985 SPE/DOE joint symposium on low permiability reservoirs. Dallas, TX; Society of Petroleum Engineers (1985). (CONF-8505115—).

From SPE/DOE symposium on low permeability reservoirs; Denver, CO, USA (19 May 1985).

Measurements of the travel time of acoustic signals transmitted between wells at the Department of Energy Multi-Well Experiment site (MWX) near Rifle, Colorado, are processed and analyzed. Interpretations relevant to sand geometry and continuity have proved possible through inspection of the signal travel time plotted against the coordinates of transmitter and receiver wellbore positions, or against the coordinates of transmitter and receiver wellbore positions, or against the depth of receiver and ray path inclination. The continuity of several sands between wells is corroborated. A major lenticular sand terminating between wells could be inferred. To explore the possible distortions in tomographic images derived from crosswell data, synthetic tomographs are constructed from computed travel times of signals transmitted through idealized models from stratigraphy thought to be present at the MWX site. The synthetic tomographs, although preserving the general character of the model stratigraphy, are distorted enough that detailed interpretations are not possible. Horizontal distortions predominate in reconstructions of flat-lying stratigraphy.

0203 Drilling And Production

REFER ALSO TO CITATION(S) 33533, 33658, 33659, 33660, 33661, 33662, 33663, 33664, 33665, 33666, 33667, 33668

33671 (CONF-850339—, pp 191-198) **Summary of air quality modeling techniques for the assessment of cumulative onshore impacts of offshore oil and gas development.** Tesche, T.W.; Yocke, M.A.; Gutfreund, P.D. (Systems Applications, Inc., San Rafael, CA). Dec 1985. NTIS, PC A12/MF A01. File Number DE86007984.

From California offshore petroleum conference; Long Beach, CA, USA (26 Mar 1985).

An abridged version of the conference paper presents the range of photochemical modeling techniques available for estimating the onshore impacts of offshore oil and gas development activities. A comparison of various modeling techniques makes it clear that grid-based photochemical models exhibit a nonlinear response to changes in most of the key meteorological inputs. A general rule of thumb is that a 50% perturbation in one of the major model inputs will result in a 20 to 30% effect on the maximum ozone prediction. Current models can replicate hourly observed ozone concentrations paired in time and space to within about 25 to 30%. Wind direction and dynamics alone provide that much uncertainty in ozone predictions. 17 references.

33672 **(DOE/CE/15216—T3) Hydrostatic support sleeve and gas release probe. Final report.** (Jones (William A.) and Associates, Lotus, CA (USA)). 1986. Contract FG01-85CE15216. 8p. NTIS, PC A02. File Number DE86009817.

The very bottom line of our year's study, as shown on the detail graphs and analysis, is that the two prototypes showed a total increase of 1013%, which thus makes the average production increase 84.5%. The energy savings was similarly rewarding. On the total of 12 test units there was realized a total energy savings of 556%, with an average energy saving of 44.3% per unit. It is the theory of both this inventor and those field men with whom we have worked that with the increased carbon dioxide injections into the formations there will soon be significant problems with such gases. In those wells, as well as ones afflicted with natural gas, the pumps tested in this project will be, without a doubt, beneficial. It is estimated that there is an excellent market at the present time, and will continue to increase in the future. As an example, several producers have recently shut down wells of marginal quality and quantity due to the oil glut. However, one cannot reasonably expect that glut to continue, and in the future when those wells are reactivated, it would be appropriate to equip them with these new pump designs, which would increase production if reserves existed, and still decrease the cost to them by doing so. 2 figs.

33673 **(DOE/MC/21136—8) Improvement of CO_2 flood performance. Quarterly report, January 1-March 31, 1986.** Heller, J.P.; Kovarik, F.S. (New Mexico Inst. of Mining and Technology, Socorro (USA). New Mexico Petroleum Recovery Research Center). May 1986. Contract FC21-84MC21136. 48p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86011280.

PRRC report 86-7.

Good progress has been made this quarter in all three research areas as defined in the original proposal. In addition, new results on relevant supplementary topics are presented. The three research areas are closely interrelated: phase behavior coupled with fluid property measurements and modeling, displacement experiments to study the effects of mixing of CO_2 and oil in reservoir rocks, and the development of methods for mobility control. New phase behavior and fluid property data are being used for the mechanistic modeling of sweep efficiency and unit displacement efficiency in high pressure gas flooding and in CO_2-foam flooding. Indeed, we have data indicating that the presence of multiple liquid phases increases sweep efficiency as the flooding process is scaled up. To model reservoir flow instabilities correctly we need to understand the interactions existing between phase behavior and: (1) fluid flow; (2) mixing and rock heterogeneity; (3) wettability; and (4) capillarity. The integration of all three research areas within the project is necessary in order to provide specific information on ways to improve the ability to predict and optimize CO_2 flood performance. These research areas are described fully. 9 refs., 10 figs., 1 tab.

33674 **(DOE/METC—86-4062) Wettability and its implications for enhanced oil recovery.** Das, K.; Puon, P.S. (USDOE Morgantown Energy Technology Center, WV). Sep 1985. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86006606.

Reservoir rock wettability determines capillary pressure, fluid distribution, relative permeability and electrical properties and may play an important role in waterflood recovery efficiency. This report covers a literature survey of wettability, its significance, and its effect on oil recovery processes. Wettability is usually indicated by a contact angle that is measured on single crystals of quartz or calcite using crude oil and formation or synthetic brine. For porous samples, displacement methods are commonly used. The wettability of reservoir rock depends largely on polar compounds and asphaltenes in the crude oil and can range from strongly water-wet to strongly oil-wet, the latter being fairly common in carbonate reservoirs. Recovery efficiency has been reported to be most favorable at intermediate or mixed wettability. Modification of natural wettability has been conducted in the laboratory and observed in field applications. 56 refs., 5 figs., 2 tabs.

33675 **(DOE/SF/11564—15) Foams in porous media.** Marsden, S.S. (Stanford Univ., CA (USA). Petroleum Research Inst.). Jul 1986. Contract AC03-81SF11564. 27p. (SUPRI-TR—49). NTIS, PC A03/MF A01; GPO Dep. File Number DE86000290.

In 1978 a literature search on selective blocking of fluid flow in porous media was done by Professor S.S. Marsden and two of his graduate students, Tom Elson and Kern Huppy. This was presented as SUPRI Report No. TR-3 entitled "Literature Preview of the Selected Blockage of Fluids in Thermal Recovery Projects." Since then a lot of research on foam in porous media has been done on the SUPRI project and a great deal of new information has appeared in the literature. Therefore we believed that a new, up-to-date search should be done on foam alone, one which would be helpful to our students and perhaps of interest to others. This is a chronological survey showing the development of foam flow, blockage and use in porous media, starting with laboratory studies and eventually getting into field tests and demonstrations. It is arbitrarily divided into five-year time periods. 81 refs.

33676 (DOE/SF/11564—16) Pressure transient analysis of wells with horizontal drainholes: SUPRI TR-51. Clonts, M.D.; Ramey, H.J. Jr. (Stanford Univ., CA (USA). Petroleum Research Inst.). Jul 1986. Contract AC03-81SF11564. 116p. (SUPRI-TR—51). NTIS, PC A06/MF A01; GPO Dep. File Number DE86000291.

This study presents an analytical solution for the transient pressure response of a uniform flux horizontal drainhole in an anisotropic reservoir of finite thickness. The solution also applies for a reservoir with multiple drainholes in a vertical array. The analytical solution is developed using instantaneous source functions, Green's functions and the Newman product method. The solution shows that there are two possible types of transient pressure behavior depending on the length of the drainhole relative to the height of the resevoir. If the drainhole is short, flow is characterized by three flow periods: an initial radial flow perpendicular to the drainhole axis, a transition flow period, and a pseudo-radial flow period. If the drainhole length is long relative to the reservoir height, the initial radial flow period ends instantaneously for all practial purposes. The transient pressure behavior here is identical to that of a uniform flux veritical fracture and is characterized by early time linear flow followed by a transition period and late time pseudo-radial flow. It is demonstrated that the pressure transient response for multiple drainholes is identical to the single drainhole solution if dimensionless variable are defined relaive to the number of drainholes. Consequently, the pressure response of a uniform flux vertical fracture can also be approximated by several short drainholes. The solution for infinite conductivity drainholes is also suggested by analogy to the infinite conductivity verticl fracture solution. Log-log type curves are presented for various drainhole radii and can be ·sed in the conventional manner to determine reservoir characteristics including directional permeability or drainhole half length. Short and long time approximations are presented along with appropriate time limits. Finally, conditions for greater productivity than with vertical wells or hydraulic fractures are presented. 53 refs., 33 figs., 17 tabs.

33677 (NIPER—126) Outcrop distribution of shale bodies and natural fractures obtained by image analyzer. Tomutsa, L. (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)). Mar 1986. Contract FC22-83FE60149. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86011487.

Progress has been made in testing a novel method of study of outcrop heterogeneities - computer image enhancement. The principal advantage of this method is speed of outcrop scanning, measurement of certain features, and statistical analyses of these features. Preliminary results are encouraging but are too few to be conclusive regarding the advantages and cost effectiveness of the new method. 2 refs.

33678 (NIPER—147) Sodium bicarbonate in chemical flooding. Project OE6. Peru, D.A. (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)). May 1986. Contract FC22-83FE60149. 37p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86011281.

In this report we are presenting the results of our investigation in 3 areas: (1) the use of low pH alkaline chemicals for wettability alteration; (2) the development of a correlation between interfacial shear viscosity and water breakout for oil-brine macroemulsions; and (3) the evaluation of bicarbonate as a chemical for use in oil recovery. The main objective of our work is to develop an understanding of the mechanisms involved in bicarbonate flooding and to make specific recommendations for its potential use in enhanced oil recovery. To evaluate the use of bicarbonate as an emulsion destabilizer, emulsification and coalescence test results were compared with interfacial shear viscosities. In two of the three systems studied an inverse relationship was found between the maximum rate of water breakout and interfacial shear viscosity. Temperature and aging of the interface was a major factor affecting these results. Sodium bicarbonate and sodium carbonate were used to determine their effect on rock wettability. Sodium bicarbonate was found to change the wettability of Berea sandstone toward the water-wet state more effectively than sodium carbonate for the low acid oil, Noone crude. Highly acidic crude oils appeared to react with bicarbonate creating highly absorbed surfactants. This caused Berea sandstone to become more oil-wet. The major mechanisms of oil recovery using sodium bicarbonate include wettability alteration, emulsification followed by coalescence, and lowered interfacial shear viscosity. These mechanisms alone did not cause significant recovery of the low acid oil, Noone crude. Previous oil displacement tests indicate that bicarbonate is more effective when using acidic crude oils. The range of oils that can be recovered using bicarbonate can be extended by adding small amounts of surfactants to the bicarbonate slug. 18 refs., 3 figs., 6 tabs.

33679 Hydraulic fracture geometry modeling, prediction, and comparisons. Advani, S.H.; Khattab, H.; Lee, J.K. (Ohio State Univ.). pp 135-144 of 1985 SPE/DOE joint symposium on low permiability reservoirs. Dallas, TX; Society of Petroleum Engineers (1985). (CONF-8505115—). Contract AC21-83MC20338.

From SPE/DOE symposium on low permeability reservoirs; Denver, CO, USA (19 May 1985).

Results from an on-going DOE sponsored program related to hydraulic fracture response modeling are presented. Finite element model formulations and the solution methodology associated with a pseudo-three-dimensional hydraulic fracture model coupling fracture fluid flow and leak-off on both horizontal and vertical cross- sections with the elastic response in vertical cross-sections are described. In addition, fracture geometry evaluations and selected comparisons with available results are revealed.

0204 Processing

REFER ALSO TO CITATION(S) 33532, 33534, 33535

33680 (CONF-850339—, pp 95-99) Onshore treating and support facilities. Hundley, J.B. (Atlantic Richfield Co., Bakersfield, CA). Dec 1985. NTIS, PC A12/MF A01. File Number DE86007984.

From California offshore petroleum conference; Long Beach, CA, USA (26 Mar 1985).

A dramatic increase in offshore petroleum production requires the planning, engineering, permitting, and construction of new onshore treating and support facilities in the sensitive environmental areas of the Santa Barbara Channel and Santa Maria Basin by the late 1980s. Conventional onshore processing site treating offshore production consists of crude oil processing, produced water disposal, and gas processing. The author describes the seven current projects involved in the expansion of existing facilities and construction of new plants to handle a projected 420,000 to 550,000 bbls/day of offshore oil by the 1990s.

33681 (CONF-850339—, pp 101-105) Transportation and refining options. Zustovich, A.B. (Exxon Co., U.S.A., Houston, TX). Dec 1985. NTIS, PC A12/MF A01. File Number DE86007984.

From California offshore petroleum conference; Long Beach, CA, USA (26 Mar 1985).

Since California's limited capacity is concentrated in Los Angeles, it is necessary to transport crude oil to the Gulf coast for refining. Economic and environmental factors will determine which transportation method is accepted. The author describes the transportation and refining options, with a focus on the special characteristics and refining, the locations and capabilities of refineries available for processing, the transportation systems proposed to move the crude from treating facility to refinery, and the key parameters that determine feasibility of transportation systems. These include pipelines and tankers, with tariffs and environmental considerations the major parameters. A principal environmental issue is the risk of an oil spill, but neither transportation mode appears to have a risk advantage. 6 figures.

33682 Method for removing chlorine compounds from hydrocarbon mixtures. Janoski, E. J.; Hollstein, E. J. (to The United States of America as represented by the United States Department of Energy). US Patent 4,561,969. 31 Dec 1985. Filed date 28 Sep 1984. vp.

PAT-APPL-655598.

A process for removing halide ions from a hydrocarbon feedstream containing halogenated hydrocarbons wherein the contaminated feedstock is contacted with a solution of a suitable oxidizing acid containing a lanthanide oxide, the acid being present in a concentration of at least about 50 weight percent for a time sufficient to remove substantially all of the halide ion from the hydrocarbon feedstock.

33683 **Removal of arsenic compounds from spent catecholated polymer.** Fish, R. H. (to The United States of America as represented by the United States Dept. of Energy). US Patent 4,552,854. 12 Nov 1985. Filed date 8 Feb 1985. vp. PAT-APPL-699886.

Described is a process for removing arsenic from petroliferous derived liquids by contacting said liquid at an elevated temperature with a divinylbenzene-crosslinked polystyrene having catechol ligands anchored thereon. Also, described is a process for regenerating spent catecholated polystyrene by removal of the arsenic bound to it from contacting petroliferous liquid as described above and involves: treating said spent catecholated polystyrene, at a temperature in the range of about 20° to 100° C. with an aqueous solution of at least one carbonate and/or bicarbonate of ammonium, alkali and alkaline earth metals, said solution having a pH between about 8 and 10, and separating the solids and liquids from each other. Preferably the regeneration treatment is in two steps.

0205 Products And By-products

REFER ALSO TO CITATION(S) 33500, 33715

33684 **(AD-A—163527/5/XAB) Evaluation of Army engine oils in hydraulic/power-transmission-system components. Final report, August 1984-November 1985.** Marbach, H.W.; Lestz, S.J. (Southwest Research Inst., San Antonio, TX (USA). Belvoir Fuels and Lubricants Research Facility). Nov 1985. 38p. (BFLRF—203). NTIS, PC A03/MF A01.

The objective of the MACI Hydraulic System and Components Program is to perform technical evaluation and assessment of commericially available qualified and fielded Army engine oils and to determine if such oils can be used as hydraulic fluids in Army commercial construction equipment and material-handling equipment. Five Army specification engine lubricants--four MIL-L-2104D (one grade 10W, one grade 30, two grade 15W-40) and one MIL-L-46167, grade 0W-20--were evaluated using four critical component performance tests used by manufacturers. Data compiled from this and previous work have shown that the limiting factors of the Army engine oils used as hydraulic and multipurpose power transmission fluids appear to be (1) wet-brake chatter noise, (2) hydraulic-pump wear problems with some piston pumps using MIL-L-46167 Arctic engine oils at temperatures hotter-than-expected Arctic conditions, and possibly (3) copper corrosion. The prime area of concern is the wet-brake chatter noise.

33685 **(AD-A—163590/3/XAB) Development of a test method to determine potential peroxide content in turbine fuels. Interim report, 1 May 1984-31 March 1985.** Fodor, G.E.; Naegeli, D.W.; Kohl, K.B.; Cuellar, J.P. (Southwest Research Inst., San Antonio, TX (USA). Belvoir Fuels and Lubricants Research Facility). 1 Jun 1985. 41p. (BFLRF—199). NTIS, PC A03/MF A01.

A test method was developed for the prediction of peroxide potential of fuels, experimental conditions were sought so that the oxidative tendencies of fuels could be assessed within a reasonable time i.e., less than 48 hours. Through the generally accepted 43 C bottle storage method for accelerated fuel aging, the relative ratings of four selected fuels oxidative tendencies were established. A matrix of experiments was designed to allow selection of those short-term reaction conditions that would give results comparable to the 43 C bottle storage experiments. Additionally, the results of these experiments would allow the development of global reaction kinetics to aid the determination of fuel peroxidation potential. From a partially completed experimental matrix, fuel stressing was completed at 60 and 100 C under an initial oxygen pressure of 689 kPa (100 psig). Experimental results at 60 C gave inconclusive results. Results of the 100 C experiments produced essentially self-consistent results that also agreed with those of the bottle storage for the most-stable and least-stable fuels. Results of the two intermediate stability fuels, however were interchanged.

33686 **(AD-A—163724/8/XAB) Fire-resistant fuel program analysis and program management documentation. Final report, December 1985-January 1986.** Dye, C.A. (Science Applications International Corp., McLean, VA (USA). Military Operations Analysis Div.). 31 Jan 1986. 49p. (SAIC—86/1024). NTIS, PC A03/MF A01.

There was an urgent need to transition management of the Fire Resistant Fuel (FRF) Program from the Materials Fuels and Lubricants Laboratory (MFLL) to the Logistics Support Directorate (LSD). It is recommended that the LSD develop program management documentation (PMD) that supports a Milestone I review as soon as possible to include the following: System Concept Paper, Concept Formulation Package and a Test Evaluation Master Plan. This report describes programmatic analyses and subsequent programmatic recommendations.

33687 **(PB—86-153897/XAB) At-sea test and demonstration of petroleum coke-oil mixtures (PETCOM). Final report.** Hastings, K.E. (Cities Service Research and Development Co., Tulsa, OK (USA)). Oct 1985. 305p. NTIS, PC A14/MF A01.

Cities Service Research and Development Company, in association with COMCO of America, Duval (Pennzoil) Corporation, Marine Transport Lines, Seaworthy Systems, and John Zink Company, developed a program for commercial demonstration of petroleum coke/oil mixtures (PETCOM) onboard a U.S. maritime vessel. The program was funded jointly by the U.S. Maritime Administration (MARAD), and the above industrial participants. The program contained those items necessary to conduct the first ship demonstration of burning PETCOM during a four-month test period in order to fully assess its economic and technical merits. Some of the foremost experts in the U.S. on slurry fuels were brought together for this test to produce, transport, and use PETCOM onboard a U.S. flag ship.

0206 Health And Safety

REFER ALSO TO CITATION(S) 33741

33688 (LMF—114, pp 287-294) **Pulmonary carcinogenicity of diesel exhaust in rats.** Mauderly, J.L.; Jones, R.K.; Griffith, W.C.; Henderson, R.F.; McClellan, R.O. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

Lungs of 131-143 rats/group exposed by inhalation for up to 30 mo to diesel exhaust at soot concentrations of 0.35, 3.5, and 7.0 mg/m^3 were examined in detail for lung tumors. Adenocarcinomas were found in control and low-level rats, adenomas predominated at the medium level, while adenocarcinomas and squamous cysts predominated at the highest level. One squamous carcinoma was observed at the high level. Tumor incidence (both total and malignant) was significantly increased at the high level, but not at the medium level. The percentages of rats with tumors in the control, low, medium, and high groups were 1.4%, 0.7%, 4.6%, and 16.1%, respectively. Although man is not likely to be exposed to exhaust at concentrations shown to increase tumor incidence in this study, diesel exhaust provides a model that may improve our understanding of the mechanisms of pulmonary carcinogenicity. 5 references, 3 figures, 3 tables.

33689 (LMF—114, pp 308-311) **Effect of pre-exposure to benzo(a)pyrene, nitropyrene, and SO_2 on metabolism of benzo(a)pyrene and nitropyrene in lungs and nasal tissue of rats.** Bond, J.A.; Wolff, R.K.; Freynick, J.; Seiler, F.A.; McClellan, R.O. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

Pre-exposure of rats for 4 wk to diesel exhaust particles resulted in a twofold increase in the metabolism of 1-nitropyrene by

rat respiratory tract tissue. The experiments reported here were designed to investigate which individual constituents of diesel exhaust were responsible for the observed enzyme induction. Rats were exposed nose-only for 2 h or for 4 wk (2 h/day, 5 day/wk) to either air only, benzo(a)pyrene (BaP), 1-nitropyrene (NP), or SO_3. Nasal tissue and lungs were removed from the rats and the metabolism of ^{14}C-BaP and of ^{14}C-NP was investigated. After a 2-h exposure to BaP, nasal tissue metabolism of ^{14}C-BaP was increased twofold over controls. After a 4-wk exposure to NP, nasal tissue metabolism of ^{14}C-NP was decreased to 30% of controls. Exposure to SO_3 for 2 wk increased ^{14}C-NP metabolism and decreased ^{14}C-BaP metabolism in the lungs. 2 references, 2 figures.

33690 (LMF—114, pp 359-363) **Species differences in release of mediators from diesel soot-laden macrophages.** Henderson, R.F.; Leung, H.W.; Harmsen, A.G.; McClellan, R.O. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

In life-span studies in CD-1 mice and F344/Crl rats, inhaled diluted diesel exhaust was highly fibrogenic in rats but not in mice. The authors tested the hypothesis that the greater fibrogenicity of the soot in rats was due to greater release of mediators of inflammation from alveolar phagocytic cells in rats compared to mice. Diesel-exposed rats had fivefold increases in the bronchoconstrictive prostaglandin PGF/sub 2α/, and twofold increases in the inflammatory leukotriene LTB_4. Mice had twofold increases in both parameters. Cultured rat lavage fluid cells released larger amounts of LTB_4 than mouse cells. The data are consistent with the hypothesis that soot-laden rat alveolar cells release greater quantities of mediators of inflammation than do the alveolar cells in mice. 4 references, 3 tables.

0207 Marketing And Economics

REFER ALSO TO CITATION(S) 33698, 33718

33691 (CONF-850339—, pp 231-237) **Growth and employment impacts of California offshore oil and gas development.** Niehaus, R.D. (Applied Economic Systems, Inc., Santa Barbara, CA). Dec 1985. NTIS, PC A12/MF A01. File Number DE86007984.

From California offshore petroleum conference; Long Beach, CA, USA (26 Mar 1985).

Offshore oil activities create jobs, income, and tax revenues. There are three kinds of growth drivers in the areas near the development: (1) on-site jobs at offshore and onshore locations, (2) procurement of goods and services, and (3) indirect effects from the respending of worker's earnings. A five-year forecast for the Ventura, Santa Barbara, and San Luis Obispo region examines how each of these driving forces will affect the economic and population growth of the area in four scenarios. Policy implications include the distribution of benefits, the need for a corresponding growth in other economic areas, and the need for better data upon which to base policy decisions. 1 figure, 4 tables.

33692 (DOE/EIA—0035(86/02)) **Monthly energy review, February 1986.** (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). 27 May 1986. 131p. NTIS, PC A07/MF A01; 1 - GPO; GPO Dep. File Number DE86010760.

Production consumption, and net imports are tabulated for the US.

33693 (DOE/EIA—0109(86/03)) **Petroleum Supply Monthly.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). Mar 1986. 106p. NTIS, PC A06/MF A01; 1 - GPO; GPO Dep. File Number DE86010928.

A feature article is included on petroleum capacity trends and outlook. Statistical data are presented. (PSB)

33694 (DOE/EIA—0340(85)/1) **Petroleum Supply Annual 1985. Volume 1.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 22 May 1986. 139p. NTIS, PC A07/MF A01; 1 - GPO; GPO Dep. File Number DE86010929.

Information on US supply and disposition of crude oil and petroleum products is provided for each year from 1973 through 1985, with monthly data for the most recent 3 years. Volume I contains two sectionc, petroleum supply summary and refinery capacity. Graphs and tables are presented which show 13 years of data depicting the balance between supply, disposition and ending stocks for various commodities including crude oil, motor gasoline, distillate fuel oil, residual fuel at and liquefied petroleum gases. Tables also provide 1985 detailed statistics on supply and disposition, refinery operations, imports and exports, stocks and transportation of crude oil and petroleum products. The refinery capacity section describes major activities within the refinery industry during 1985. Of particular note are listings of facilities and associated capacities in each state. In addition, summaries of corporate refinery capacities, refinery storage facilities in selected states, refinery shutdowns during 1985, refinery sales and mergers since 1981, and projected changes in input and production during 1986 and 1987 are provided. 12 figs., 42 tabs. (AT)

33695 (DOE/EIA—M015) **Model documentation for the Oil Market Module of the Intermediate Future Forecasting System.** Shaw, S.H. (USDOE Energy Information Administration, Washington, DC. Energy Analysis and Forecasting Div.). Apr 1986. 55p. NTIS, PC A04/MF A01 - GPO; GPO Dep. File Number DE86007862.

This report documents the Oil Market Module of the Intermediate Future Forecasting System (IFFS). IFFS is a computerized analytical model used by the Energy Information Administration (EIA) to make annual projections of integrated energy markets through 1995. Components of the supply, conversion, and demands for energy are represented as submodels or modules of IFFS. The Oil Market Module of IFFS (OMM) represents domestic oil refining and petroleum product pricing and distribution. Domestic production of crude oil and natural gas liquids and all petroleum product consumption, except for refinery fuel, are computed in other modules of IFFS. IFFS represents the current state of energy markets and projects the likely trends, given the available data and understanding of the market forces. By representing the total demand for energy and the interfuel competition between the various sources of energy, the model formulates a comprehensive and internally consistent analysis under a set of input assumptions. IFFS achieves the solution by solving for the economic equilibrium at which the supplies and demands for energy are equal, under the assumption that both producers and consumers of energy respond to changes in price. Chapter 2 discusses the structures of both IFFS and OMM. Chapter 3 describes the methodology and computations in OMM. Chapter 4 describes the data sources and derivations and calibration procedures. Chapter 5 provides an overview of OMM software. Additional details and a bibliography of data sources are provided in Appendix A, and a list of model variables is provided in Appendix B.

33696 (DOE/PE/70264—T1) **Analysis of leaded and unleaded gasoline pricing. Final report.** (Energy and Environmental Analysis, Inc., Arlington, VA (USA)). 15 Mar 1985. Contract AC01-81PE70264. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86009524.

This report summarizes the evaluation of the cost price relation between the two fuels. The original scope of work identified three separate categories of effort: Gather and organize available data on the wholesale and retail prices of gasoline at a national level for the past 5 years. Using the data collected in Subtask 1, develop models of pricing practices that aid in explaining retail markups and price differentials for different types and grades of gasoline at different retail outlets in the current gasoline market. Using the data from Subtask 1 and the analysis framework from Subtask 2, analyze the likely range of future retail markups and price differentials for different grades of leaded and unleaded gasoline. The report is organized in a format that is different than suggested by the subtasks outlined above. The first section provides a

characterization of the problem - data available to quantify cost and price of the fuels as well as issues that directly affect this relationship. The second section provides a discussion of issues likely to affect this relation in the future. The third section postulates a model that can be used to quantify the relation between fuels, octane levels, costs and prices.

33697 **(PB—86-156379/XAB) Evaluation of mobile gasifiers for the OTA (Office of Technology Assessment) oil replacement analysis project. Working paper.** (Rasor Associates, Inc., Sunnyvale, CA (USA)). Nov 1984. 121p. NTIS, PC A06/MF A01.

The Office of Technology Assessment (OTA) of the US Congress is analyzing various options for minimizing the impact of a 3 to 4 million barrels per day (MMbbl/d) cutoff of U.S. oil imports. As part of the project, Rasor Associates, Inc., (RAI) is reviewing and evaluating mobile gasifiers as an oil replacement technology. OTA and another contractor, Gibbs & Hill, Inc., (G & H), are reviewing and evaluating all other potential oil replacement technologies for the project. The evaluation of mobile gasifiers by RAI is based primarily on the survey, performed for the California Energy Commission by RAI, of previous world-wide experience with the mobile gasifier during World War II, and on recent in-house research performed on mobile gasifiers by RAI. Reference should be made to the primary sources of data for more detailed discussion of the subjects summarized here. An annotated Bibliography of the most useful publications is included as Appendix A. The format employed in the G & H study is adopted to facilitate comparison with the other oil replacement technologies evaluated. Section II of the report reviews the aspects of mobile gasifier status and technology that are specifically required for the OTA analysis. Section III discusses scenarios for implementing the use of the technology for oil replacement in the 1985-1990 period.

0208 Waste Management

33698 **(NIPER—73) Recovery of Navy distillate fuel from reclaimed product. Volume 3. Process evaluation and recommendation.** Wells, J.W.; Zagula, E.J.; Brinkman, D.W. (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)). Mar 1986. Contract AI19-81BC10525;FC22-83FE60149. 266p. NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE86010845.

The US Navy is currently seeking a way to reclaim a major portion of the approximately 15-million gallons of contaminated Navy distillate fuel generated every year by its various activities. The National Institute for Petroleum and Energy Research (NIPER) with the support of the Department of Energy (DOE) and the Navy is developing a simple, reliable, and economical process which can upgrade waste Navy distillate fuel (RP) to specification Naval Distillate Fuel (F76). This process development project consists of three phases: (1) information gathering, (2) process evaluation, and (3) conceptual validation. To date Phase I and the bench-scale testing and economic analysis of Phase II have been completed. This report describes the findings of Phase II of this effort in which seven different technologies have been evaluated for their ability to upgrade RP to F76. Only a combination of caustic pretreatment and distillation has been found to upgrade the waste fuel to specification diesel fuel. All other technologies evaluated have failed by a large margin to upgrade the RP. Conceptual design studies, economic analyses, and an environment assessment have demonstrated the simplicity, economy, and acceptability of this process. Additional studies have been used to determine the most favorable scenario for implementation of this technology. These studies show that the plant should be located at the Craney Island Fuel Depot on the concrete pad of building 69 and should have a capacity of 6-million gallons per year (expandable to 7.2-million gallons per year). This government-owned facility could be operated either by the Navy or a contractor. In this report, the avenues of research explored and the analysis tools used in reaching these conclusions are presented and discussed. 14 refs., 30 figs., 49 tabs.

0209 Environmental Aspects

REFER ALSO TO CITATION(S) 33657, 33658, 33659, 33665, 33671, 33680, 34831, 34832

33699 (CONF-850339—, pp 175-181) **Air quality issues: regulations and jurisdictions.** Hafker, W.R. (Exxon Co., U.S.A., Houston, TX). Dec 1985. NTIS, PC A12/MF A01. File Number DE86007984.

From California offshore petroleum conference; Long Beach, CA, USA (26 Mar 1985).

Air pollutants emitted during offshore oil exploration and production come from both stationary and mobile sources. Federal, state, and local agencies are each responsible for regulating some air-quality aspects of offshore development. The author describes the air quality regulations and jurisdictions affecting California. He describes the regulatory agencies involved, their areas of jurisdiction, and the mechanisms by which they control pollutant emissions. The regulatory setting includes the Clean Air Act, New Source Review, and Prevention of Significant Deterioration. Agencies at all levels of government are charged with implementation of air quality standards in an extensive regulatory framework. There are specific permitting requirements for offshore petroleum development, but some regulatory issues still need clarification.

33700 (CONF-850339—, pp 215-217) **Land use.** Guzman, D. (County of Santa Barbara, CA). Dec 1985. NTIS, PC A12/MF A01. File Number DE86007984.

From California offshore petroleum conference; Long Beach, CA, USA (26 Mar 1985).

Experiences in Santa Barbara, California illustrate the role of local land use planning in the development of offshore petroleum. Onshore development of support facilities is one of the results of offshore activity. It is important to clarify both the role and the jurisdiction of local government in the area of permits and zoning in order to see that projects are chosen with their environmental and economic impacts in mind. Santa Barbara chose a one-stop approach for permit applicants in order to coordinate procedures. The city uses a joint environmental review procedure with the federal government that ensures compliance with federal regulations and allows the local department to apply new ways to mitigate these impacts. Still needed are formal time schedules to remove some of the unpredictable aspects.

33701 (CONF-850339—, pp 227-229) **Commercial fishing issues.** Knaster, A. (City of Hidden Hills, CA). Dec 1985. NTIS, PC A12/MF A01. File Number DE86007984.

From California offshore petroleum conference; Long Beach, CA, USA (26 Mar 1985).

Issues dividing the offshore oil and the commercial fishing industries include the problems of boats colliding, damage to fish resources from seismic and other activities, and lost income opportunities for the fishing industry. California has a full complement of agencies responsible to coastal industries to address these issues. The author describes how the Joint Committee, made up of four representatives of each industry works together to determine through research whether the claims of the fishing industry are valid. By cooperating in their research, they hope to arrive at a consensus. Still to be resolved is who bears the economic cost of mitigating environmental impacts.

33702 (CONF-850339—, pp 23-25) **Public concerns in offshore development.** Bradley, T. (City of Los Angeles, CA). Dec 1985. NTIS, PC A12/MF A01. File Number DE86007984.

From California offshore petroleum conference; Long Beach, CA, USA (26 Mar 1985).

The environmental impacts of offshore drilling affect the tourist and recreation industry of southern California, damage wildlife, and threaten the state's air quality standards. Seeing no concern on the part of the Department of the Interior for the Californians who will be affected, state politicians view the offshore moratorium as the only effective way to bar indiscriminate offshore leasing. Mayor Bradley sees the latest five-year plan as a continuation of unacceptable practices of the past.

33703 (CONF-850339—, pp 27-31) **Environmental options in energy supply.** Wise, J. (Environmental Protection Agency, San Francisco, CA). Dec 1985. NTIS, PC A12/MF A01. File Number DE86007984.

From California offshore petroleum conference; Long Beach, CA, USA (26 Mar 1985).

Given the complexity of environmental considerations in energy supply, it is important to remember that environmental concerns are only one factor in the overall energy equation. The author summarizes and groups some of the expected environmental impacts of offshore oil exploration and production, and suggests a comparative analysis to determine the relative impacts of different energy sources. He describes two overriding lessons: (1) the combustion of fossil fuels yields heat which produces work, and (2) we must accelerate the process of designing and implementing a balanced energy and environmental policy. To do this will require the attention of government, industry, and the public in a reasonable dialogue.

33704 (CONF-850339—, pp 33-36) **California's resource development and the public interest.** Duffy, G. (State of California Dept. of Environmental Affairs, Sacramento). Dec 1985. NTIS, PC A12/MF A01. File Number DE86007984.

From California offshore petroleum conference; Long Beach, CA, USA (26 Mar 1985).

California's Secretary of Environmental Affairs sees no need to compromise either environmental protection or energy development if there is cooperation and communication between interested parties. California's agreements with the US Department of Interior provide more environmental safeguards than were achieved through years of litigation. Residents who would preclude all offshore drilling must recognize federal authority, but should also acknowledge that a dialogue between state and federal officials will accomplish more than confrontation. Moratoria do not accomplish as much as resolving controversy and making difficult decisions.

33705 (CONF-850339—, pp 135-138) **Muds and cuttings.** Jenkins, K. (California State Univ., Long Beach). Dec 1985. NTIS, PC A12/MF A01. File Number DE86007984.

From California offshore petroleum conference; Long Beach, CA, USA (26 Mar 1985).

The author explains about muds and cuttings: what they are, where they must go, what there effects are. He focuses on water-based fluids used for offshore drilling, which are complex effluents. The problems associated with their effects and treatment, however, are not more difficult than other problems the oil industry must solve. The important thing is to watch for particularly sensitive areas where organisms or marine communities are near development sites. Awareness of these areas can encourage the use of less toxic additives. The real challenge is in establishing cause and effect because the effects appear to be finite and limited. The major worry would be very sensitive areas near the development site, particularly in areas of low energy and shallow water where there is not going to be rapid dispersion of discharged drilling fluids.

33706 (CONF-850339—, pp 139-141) **Oil spills: contingency planning and response.** Onstad, L.A. Dec 1985. NTIS, PC A12/MF A01. File Number DE86007984.

From California offshore petroleum conference; Long Beach, CA, USA (26 Mar 1985).

A description of California's integrated oil spill response system focuses on the southern region. Despite predictions of significant spills, the record to date shows 20-25 spills a year of an average of one barrel per spill during the past 8 years. The largest spill was 20 barrels. With the exception of one incident, tanker spills have also been small. Oil spill plans are prepared and coordinated at all levels of government. Major components are notification procedures, equipment requirements for operating companies, and a well trained, practiced group of people who are responsible for responding to spills. The system is comprehensive and well tested.

33707 (CONF-850339—, pp 143-148) **Oil spills: fates and effects.** Foster, M.; Thum, A.B. (Moss Landing Marine Lab., CA). Dec 1985. NTIS, PC A12/MF A01. File Number DE86007984.

From California offshore petroleum conference; Long Beach, CA, USA (26 Mar 1985).

The literature and experience indicate that it is nearly impossible to make other than general predictions about the fate and effects of a particular spill. Each spill is unique, and this individual variation produces significant and unpredictable differences in effects. The authors agree with Neushal (1970) that it is best to emphasize prevention and cleanup procedures that do not cause more damage than the oil itself. A more rigorous understanding of the generalized fates and effects may be only locally applicable after the damage has occurred at best. While comprehensive determinations are necessary to establish appropriate penalties and mitigation measures, a better understanding of both the local and global effects of chronic and cumulative oil pollution is needed. 22 references, 1 figure.

33708 **(PB—86-148376/XAB) Oil-spill risk analysis for the central and western Gulf of Mexico (proposed sales 104 and 105) Outer Continental Shelf lease areas. Final report.** Anderson, C.M.; LaBelle, R.P.; Lucas, A.D. (Minerals Management Service, Reston, VA (USA)). Apr 1985. 94p. (OCS/MMS—85/0103). NTIS, PC A05/MF A01.

The Federal Government has proposed to offer Outer Continental Shelf (OCS) lands in the Central and Western Gulf of Mexico for oil and gas leasing. The report examines what could happen if oil is found, and attempts to compare relative risks of future leasing with risks of existing leases and transportation of imported oil in the study area. The report summarizes results of an oil-spill risk analysis conducted for the proposed OCS lease offerings in the Central Gulf (Sale 104) and Western Gulf (Sale 105) Planning Areas. For the most likely find volume scenario, the proposed lease offering will result in an estimated 0.25 billion barrels of oil being found and produced over a period spanning 18 years. There is a 60% chance that no spills of 1000 barrels or larger will occur and contact land. There is little risk to all targets from the most likely find volume scenario. The highest probability (38 percent) of one or more spills occurring and contacting targets is to the Gulf-wide marshes target. The highest probability (10 percent) of occurrence and contact to land segments is to land segment number 10, on the Texas coast.

33709 **(PB—86-150109/XAB) Outer Continental Shelf environmental assessment program. Final reports of principal investigators. Volume 34.** (National Ocean Service, Anchorage, AK (USA). Ocean Assessments Div.). Aug 1985. 426p. NTIS, PC A19/MF A01.

The report is a compilation of three final reports dealing with geologic processes and hazards of the Beaufort and Chukchi Sea Shelf and coastal regions: Beaufort and Chukchi, seacoast permafrost studies; and the environmental geology and geomorphology of the Barrier Island-lagoon system along the Beaufort Sea coastal plain from Prudhoe Bay to the Colville River. Fifteen oversized maps are included.

33710 **(PB—86-170719/XAB) Preliminary analysis of oil-slick combustion. Final report.** Wichman, I.S. (National Bureau of Standards, Washington, DC (USA). Center for Fire Research). Nov 1985. 20p. (NBSIR—85/3266). NTIS, PC A02/MF A01.

The preliminary study of oil-slick combustion contains a literature review, a formulation of a physical model of oil-slick burning, and some suggested experiments. The theoretical model is divided into three stages; (1) an ignition and acceleratory-growth stage; (2) a slowdown regime, in which finite slick-thickness effects become important; and (3) an extinction cycle. The proposed experiments emphasize the use of the Fire Research Laboratory, located on the NBS grounds.

0220 Transport, Pipelines, And Handling

REFER ALSO TO CITATION(S) 33681

0240 Storage

REFER ALSO TO CITATION(S) 33731

33711 **(GAO/OGC—86-5) [Budget authority for the Strategic Petroleum Reserve].** Bowsher, C.A. (General Accounting Office, Washington, DC (USA). Office of the Comptroller General). 25 Feb 1986. 4p. General Accounting Office, Box 6015, Gaithersburg, MD 20760. File Number TI86901402.

On February 5, 1986, the President's third special message for fiscal year 1986 was submitted to the Congress pursuant to the Impoundment Control Act of 1974. This letter is our report, as required by section 1014(b) of the Act, U.S.C. S 685, on one deferral in that message, affecting budget authority for the Strategic Petroleum Reserve. We conclude, for the reasons given in this letter, that of the $197.9 million deferred, the withholding of $156.8 million is not in accordance with existing statutory authority. We do not in this report question the deferral of the remaining $41,140,825 of budget authority. We are continuing to examine this deferral, and will advise you if we conclude that it, too, is impermissible under the Impoundment Control Act. We will report separately on the remainder of the third special message.

03 NATURAL GAS

0302 Geology And Exploration

REFER ALSO TO CITATION(S) 33670, 33713

33712 **(DOE/MC/21179—2032) Rock matrix and fracture analysis of flow in western tight gas sands. 1985 annual report.** Morrow, N.R.; Ward, J.S.; Brower, K.R. (New Mexico Inst. of Mining and Technology, Socorro (USA). New Mexico Petroleum Recovery Research Center). Feb 1986. Contract AC21-84MC21179. 75p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86001055.

The objective of this project is to develop reliable core analysis techniques for tight gas sands; these are essential to proper formation evaluation. The study is mainly concerned with the dependence of flow in tight gas sands on water saturation and confining pressure. This dependence is to be related to the detailed pore structure of tight sands as typified by cores recovered in the Multi-Well experiment. High-speed centrifuge and adsorption isotherms have been used in combination to obtain information about pore sizes and surface areas of tight sands. Flow properties of mineralized fractures have been measured. Attention is also being given to the presence of unhealed (open) fractures. The project has the following four major tasks concerned with research and advanced analysis on core from the Multi-Well field experiment and other core as appropriate: (1) advanced core analysis; (2) natural fractures and heterogeneities; (3) changes in core properties; and (4) water saturation. Progress reports are presented for these tasks. 40 refs., 34 figs., 8 tabs.

0303 Drilling, Production, And Processing

REFER ALSO TO CITATION(S) 33676, 33720

33713 **(DOE/TIC—11417) Unconventional gas sources. Vol. I. Executive summary.** Bookout, J.F. (USDOE Energy Information Administration, Washington, DC). Dec 1980. 50p. NTIS$6.50.

NPC's analysis of unconventional gas resources concludes that natural gas from coal seams, Devonian shale, and tight gas reservoirs could contribute up to 14 trillion CF/yr by 2000 at gas prices up to $9/million Btu. Production from geopressured brines will probably be negligible, perhaps 0.08 TCF/yr. Considerable uncertainty exists, however, in NPC's estimates of reserves additions and production rates for any specified economic condition; even the resource-base assessments may be in error. The rate of development of all unconventional sources will depend strongly on economics. Because the estimates assume that markets will exist for the producible gas, government actions affecting gas usage could significantly influence production rates. Furthermore, the development of these resources will require substantial risk and huge capital investment (probably more than $200 billion), and unconventional gas will have to compete against conventional production as well as other emerging technologies (such as coal gasification) for its share of the available monies.

33714 **Hydrodesulfurization catalysis by Chevrel phase compounds.** McCarty, K. F.; Schrader, G. L. (to The United States of America as represented by the United States Department of Energy). US Patent 4,560,470. 24 Dec 1985. Filed date 20 May 1985. vp.

PAT-APPL-736154.

A process is disclosed for the hydrodesulfurization of sulfur-containing hydrocarbon fuel with reduced ternary molybdenum sulfides, known as Chevrel phase compounds. Chevrel phase compounds of the general composition M /SUB x/ Mo_6S_8, with M being Ho, Pb, Sn, Ag, In, Cu, Fe, Ni, or Co, were found to have hydrodesulfurization activities comparable to model unpromoted and cobalt-promoted MoS_2 catalysts. The most active catalysts were the "large" cation compounds (Ho, Pb, Sn), and the least active catalysts were the "small" cation compounds (Cu, Fe, Ni, Co.).

0304 Products And By-products

33715 **(PB—86-160900/XAB) Liquefied-petroleum-gas industry profile. Volume 1. An overview of the industry (1944-1980). Final report.** Gazda, W.; Forman, C.; Zebe, P. (Department of Transportation, Cambridge, MA (USA). Transportation Systems Center). Nov 1985. 80p. (DOT-TSC-RSPA—85-9). NTIS, PC A05/MF A01.

The report provides a broad, factual description of the U.S. liquefied petroleum gas (LP-gas) industry. The basic purpose of the report is to provide analysts and policymakers in government and industry with a comprehensive overview of the LP-gas industry that can be used as a tool in the decision-making process. The report is contained in two volumes: Volume I provides the basic discussion of the LP-gas industry. Volume II supplements the presentation of Volume I with appendices containing additional detail on selected topics.

0305 Health And Safety

REFER ALSO TO CITATION(S) 33730

0306 Marketing And Economics

REFER ALSO TO CITATION(S) 33692

33716 **(DOE/EIA—0130(86/03)) Natural Gas Monthly, March 1986.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 20 May 1986. 160p. NTIS, PC A08/MF A01; 1 - GPO; GPO Dep. File Number DE86010904.

Current data on natural and supplemental gas consumption, disposition, production, prices, storage, imports, and exports in the United States are provided for each year from 1980 through February 1986, with monthly data for the most recent 3 years. Some data are also given by state or city; some data are also given for previous years. Operating and financial data for major interstate natural gas pipeline companies, as well as data on filings, ceiling prices, and transportation under the Natural Gas Policy Act of 1978, are also included. Explanatory notes, a discussion of data sources, and a glossary are included. Three reports previously published as separate annuals are now published in this report. The three are: "Underground Natural Gas Storage in the United States" (DOE/EIA-

0239); "US Imports and Exports of Natural Gas" (DOE/EIA-0188); and "Main Line Sales of Natural Gas to Industrial Users" (DOE/EIA-0129). Featured article for this month is "An Analysis of Federal Energy Regulatory Commission Order 436. 6 figs., 34 tabs.

33717 **(DOE/EIA—0281) Energy transitions: the forecasts through 2020.** Hutzler, M.J.; Reynolds, A.W.; Cornet, C.M. (National Petroleum Council, Washington, DC (USA)). Mar 1981. 50p. GPO$2.50.

Prepared for the 1980 annual report to Congress, EIA's forecasts of U.S. energy supply and demand through 2020 point to an impending transition from oil and gas to other energy resources. The projections use an integrated system of models for three time periods: short-term (through 1981), midterm (for 1985, 1990, and 1995), and long-term (through 2020). The study's two major assumptions are (1) world oil prices (in 1979 constant dollars and adjusted for inflation) of $42-$93/bbl in 2000 and $58-$134/bbl in 2020 and (2) GNP growth rates of 2.5%/yr through 2000 and 2%/yr for 2000-2020. A sensitivity analysis examines the effects of variations in oil price, energy demand, capital-cost assumptions, and nuclear-power developments. Also included are comparisons of EIA's forecasts with those of Exxon Corp.; Data Resources, Inc.: H. Landberg et al. (Resources for the Future); and R. Stobaugh and D. Yergin (Harvard University). The major long-term energy problem, according to EIA, will be satisfying the demand for liquid fuels either by importing more oil or by increasing domestic production, perhaps via synthetic-fuels technologies. Focusing simply on conservation and solar energy will not resolve this dilemma.

33718 **A natural gas futures market.** McFadden, R.T. (New York Mercantile Exchange, New York, NY). pp 232-235 of Gas Processors Association sixty-fourth annual convention. Tulsa, OK; Gas Processors Association (1985). (CONF-850320—).

From Gas Processors Association annual convention; Houston, TX, USA (18 Mar 1985).

The New York Mercantile Exchange operates and maintains the largest commodities market for crude oil and refined products in the world. At present, the equivalent of almost 35 million barrels of oil is traded daily on NYMEX energy futures markets. The explosive growth of energy futures trading reflects a fundamental shift in the structure of the world oil market. The expansion of the spot market, increased volatility in oil prices, and the development of new institutions, such as the futures market, are consequences of this restructuring. Most recently, we have witnessed an erosion in the control of prices by the Organization of Petroleum Exporting Countries. Where prices were once administered, they now are a function of worldwide supply and demand. In short, an international free market now sets oil prices. The growth of the international spot market for crude oil is the natural consequence of the diffusion of supply and demand. Spot market transactions now account for between 40 and 60% of all oil sales, as opposed to 8% five years ago. Coincidental with the growth of the international spot market has been the consistent growth of crude oil futures trading on the New York Mercantile Exchange. Increased price volatility and uncertainity over future prices have given firms an incentive to shift their price risks in the NYMEX futures market. Hedging allows commercial oil companies and consumers of oil to transfer their future price risk to speculative investors. Over the past two years, we have also witnessed a fundamental shift in the structure of the U.S. natural gas market. After decades of controls, a significant portion of natural gas supplies has become deregulated under the Natural Gas Policy Act. On an interstate level, estimates indicate that roughly 60% of flowing gas is free of price controls. In the Texas intrastate market these estimates are as high as 95% of total supplies.

0308 Environmental Aspects

REFER ALSO TO CITATION(S) 33709, 34810

33719 **(UCID—20771) Updates on input files of FEM3.** Chan, S.T.; Weichel, R.L. (Lawrence Livermore National Lab., CA (USA)). May 1986. Contract W-7405-ENG-48. 14p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86011700.

Since the publication of FEM3 User's Manual (UCRL-53397) in February 1983, several new capabilities have been implemented into the code. These include the phase-change submodels for both humidity and the dispersed contaminant, and the implementation of more cost-effective explicit and semi-implicit time integration schemes for solving problems involving low Prandtl number flow, such as the hydrodynamics problem in the melt of the laser isotope separation (LIS) project. Additionally, several variants of the conjugate gradient (CG) method have been implemented as alternatives to the direct, skyline solver FISSLE for solving the pressure equation. In this report, we describe some changes and updates in the input files PREPIN and FEM3IN, with emphasis on LIS applications. This report is intended as an interim, supplementary document to the existing User's Manual, UCRL-53397, prior to the issuance of a formal, revised version. The first part, related to PREPIN, is an addendum to its corresponding section in the existing User's Manual, while the second part is a revision of the section related to the preparation of input file FEM3IN and is to replace pages 60 through 64 of the User's Manual. 1 ref.

0309 Artificial Stimulation

REFER ALSO TO CITATION(S) 33679

33720 **(PB—86-154556/XAB) Co-production of gas and water, fourth year. Annual report, November 1984-October 1985.** Howell, R.W.; Peterson, K.P.; Anderson, L.L.; Parisi, W.A. (Eaton Operating Co., Inc., Houston, TX (USA)). Nov 1985. 197p. NTIS, PC A09/MF A01.

The objectives of the research effort were to locate, evaluate, acquire and test one or more co-production prospects. A prospect identification program was developed to locate prospective co-production reservoirs on the Texas Gulf Coast. The reservoirs identified were ranked according to their potential for enhanced gas recovery and are monitored and updated from industry activity on or near the prospects.

33721 **(PB—86-168754/XAB) R and D plan for the Deep Coal Seam project. (April 1983-December 1991.** Seccombe, J.C.; Sakashita, B.J.; Schwoebel, J.J. (Resource Enterprises, Inc., Grand Junction, CO (USA)). Dec 1985. 96p. NTIS, PC A05/MF A01.

The Deep Coal Seam Project is a major research and development effort in the Gas Research Institute Methane from Coal Deposits Project Area. The project is conducted in the Piceance Basin at the Red Mountain Site owned and operated by Resource Enterprises, Inc. The overall objective of the project is to develop, improve, and communicate the technology required to produce gas from deeply buried coal with reduced uncertainty and increased economic return. In order to achieve this objective, a field laboratory environment was established and project efforts focused on a deep coal reservoir at the Red Mountain Site.

33722 **Integration of laboratory and field data for insight on multiwell experiment paludal stimulation.** Sattler, A.R.; Raible, C.J.; Gall, B.R. (Sandia National Laboratories). pp 397-410 of 1985 SPE/DOE joint symposium on low permiability reservoirs. Dallas, TX; Society of Petroleum Engineers (1985). (CONF-8505115—).

From SPE/DOE symposium on low permeability reservoirs; Denver, CO, USA (19 May 1985).

Two stimulation operations have been conducted to date in the paludal zone of the Mesaverde formation in one well, MWX-1, at the DOE's Multiwell Experiment test site in the Piceance Basin near Rifle, Colorado. Problems were encountered in the second

stimulation: MWX-1 would not sustain production for several months and post-frac production was less than pre-frac rates. The laboratory program was expanded to examine these problems and these laboratory studies were integrated with well testing and other data to help explain MWX-1 production behavior. A unique explanation cannot be found for the failure of MWX-1 to produce; a combination of factors was responsible. Water probably inhibited matrix rock production. A system of naturally occurring microfractures is important in production from the paludal zone and it probably sustained damage by water and fracture fluids. The basic gel degraded slowly because only a small amount of breaker was used. The fracture closure (viscosity break) observed from the Nolte analysis of the stimulation was not the same as the breakdown of the basic gel. The remedial treatment conducted after the second stimulation was probably too reactive. A list of items has been developed from experience gained both inside and outside the laboratory that shows what work and which procedures should be emphasized or avoided in tight sand stimulations.

0320 Transport, Pipelines, And Handling

33723 **(GAO/RCED—86-87BR) Pipeline safety. Information on gas distribution system operators reporting unaccounted for gas.** (General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div.). Feb 1986. 21p. General Accounting Office, Box 6015, Gaithersburg, MD 20877. File Number TI86901399.

Briefing report to the Chairman, Subcommittee on Fossil and Synthetic Fuels, Committee on Energy and Commerce, House of Representatives.

According to Department of Transportation records, 92 of the 1491 gas distribution system operators reported high levels of unaccounted for gas (unaccounted for gas is the difference between the amount of gas purchased and sold) for 1984, the latest year for which data were available. Of the 92 gas system operators, 64 were municipals (gas systems owned by a governmental entity, such as a city or county) and 28 were nonmunicipals. Based on the data we reviewed, these 92 gas systems did not report any accidents during calendar year 1984. Part I provides more details on the unaccounted for gas of municipal gas systems. Federal and industry officials consider that unaccounted for gas in excess of 15% of gas purchases high and worthy of investigation. High levels of unaccounted for gas can occur for a number of reasons, including errors in metering and billing, not accounting for gas used by city or company facilities, and leaking gas pipelines. While it may, a leak does not always indicate a safety problem. For example, a slow leak in an open area may not be a safety hazard. The Secretary has the authority to regulate any liquid deemed hazardous when transported by pipeline, and therefore could regulate hazardous liquids not currently regulated including methanol and carbon dioxide. However, the Department of Transportation has no plans to regulate any additional liquids. Part II provides more details. 4 figs., 2 tabs.

33724 **(PB—86-157492/XAB) Natural-gas-pipeline improvement opportunities. Final report, January-November 1985.** Ford, J.J. (Ford (John) and Associates, San Diego, CA (USA)). Dec 1985. 71p. NTIS, PC A04/MF A01.

The U.S. natural-gas-pipeline system is built to deliver up to 20 trillion cubic feet per year to gas customers. It consumes about 700 billion cubic feet of gas in transporting this supply. This project was undertaken to identify research and development areas that would reduce the transmission fuel requirements of the system. Six of these improvements are recommended for future development and commercialization. Combined they represent a potential savings of nearly $900 million annually. These six tasks are: Turboexpanders at pressure taps, computerized control systems, clean-burn retrofit of existing gas engines, retrofit improved more durable valves in reciprocating compressors, install recuperators on low pressure ratio gas turbines, and surge detection on centrifugal compressors.

0330 Properties

33725 **(PB—86-163730/XAB) Low-cost gas Btu measurements using sensor-array processing. Phase 2, July 1983-March 1984.** Pearman, A.N.J. (Honeywell, Inc., Roseville, MN (USA). Technology Strategy Center). Apr 1984. 86p. (REPT—84252). NTIS, PC A05/MF A01.

The objective of the program is to demonstrate the feasibility of using low-cost sensors in an array to compute the heating value of the gas.

33726 **(PB—86-168747/XAB) Data acquisition for natural gas supercompressibility factors. Final report, 1 January 1983-31 December 1984.** Hall, K.R.; Holste, J.C.; Eubank, P.T. (Texas A and M Univ., College Station (USA). Research Foundation). Jan 1985. 40p. NTIS, PC A03/MF A01.

The objective of the research was to provide PVT data covering the ranges 200 < or = T/K < or = 400 and 0 < or = P/bar < or = 350 for natural-gas components and mixtures. A Burnett-isochoric apparatus was the primary vehicle for the study. It was capable of precisions: 0.001% for pressure, 0.002 K in temperature, 0.02% density. During the project, the authors collected data on CO_2, equimolar CO_2+CH_4, equimolar CO_2+N_2, and a 90 mol % CH_4+10 mol % CO_2 mixture. In all, there are about 400 data points covering these systems. There are primarily density data, but they also define the phase boundaries between vapor and liquid regions. Although not part of the report, it is also possible to extract values of energy, enthalpy, entropy, Helmholtz energy and Gibbs energy from these data. The basic densities are accurate within about 0.05%. The driving force for collecting these specific data is the data correlation project which GRI has funded at the University of Oklahoma which seeks an accurate equation of state for natural gas. These data serve as a significant portion of their database and as benchmark data for checking instrument calibrations.

0340 Combustion

REFER ALSO TO CITATION(S) 34224, 34227, 34319

33727 **(PB—86-154010/XAB) Formation of a natural-gas-engine data base. Final report, April 1984-January 1985.** Kamo, R.; Kamo, L. (Adiabatics, Inc., Columbus, IN (USA)). 31 Oct 1985. 80p. NTIS, PC A05/MF A01.

A study was conducted to assess the present natural-gas-engine technology with the objective of laying the groundwork for the development of advanced natural-gas powerplants. Literature search, consultations, field trips, overseas visits, and analyses were performed to identify the critical path and a network diagram for the future was constructed. Today's engine base was reviewed and, worldwide, natural-gas engines in the five to 1000-horsepower range are presented. Problem areas of the natural-gas engines were identified with near-term fixes and long term development work. Some new powerplants technologies; namely, adiabatic turbocompound, two-stroke engines, the rotary engine, and gas turbines are beginning to show potential for natural gas powerplants. For high engine performance, a Miller cycle with fuel injection, lean combustion, high compression ratio and turbocharging is recommended together with adequate use of ceramic and other advanced materials for long life (40,000 hours) natural gas engine.

33728 **(PB—86-156114/XAB) Oxygen enriched air/natural gas burner system development. Annual report, July 1984-June 1985.** Joshi, S.V. (Air Products, Inc., Allentown, PA (USA)). Jul 1985. 41p. NTIS, PC A03/MF A01.

Air is said to be enriched when the oxygen concentration is increased beyond the normal 20.9%. Oxygen enrichment is known to increase the flame temperature, improve process efficiency, and lower energy consumption. A market survey was performed to characterize high-temperature industrial production processes that use natural gas. The benefits of enrichment are compared to other methods of energy conservation. The state-of-the-art air-fuel burners are identified for detailed evaluation with oxygen enrichment.

33729 (PB—86-168770/XAB) Applying chemical kinetics to natural-gas combustion problems. Annual report, September 1984-August 1985. Westbrook, C.K. (Lawrence Livermore National Lab., CA (USA)). 1 Sep 1985. 134p. NTIS, PC A07/MF A01.

Kinetic modeling techniques were applied to two GRI-supported programs. Computational analysis of the successive reignition of methane-air mixtures under conditions similar to those encountered in research pulse combustors has shown that the lean and rich limits of operation are, to a considerable extent, kinetically controlled. For mixtures outside these limits, the times required for reignition are too long to permit stable operation of the pulse combustion system. However, analysis of the pulse combustion experiments carried out at Battelle Columbus Laboratories under GRI support has shown that another rich limit near stoichiometric conditions must be due to a limited rate of mixing between hot reaction products, fresh fuel, and fresh air. Computational analysis of the laminar flame experiments carried out at UTRC under GRI support has shown that for methane-oxygen-argon flames seeded with NO, the experimentally observed reduction in No levels can be satisfactorily explained by means of the NOx kinetic mechanisms developed by Miller and co-workers at Sandia Livermore.

0350 Storage

33730 (PB—86-156122/XAB) Human factors applications to computer-aided system design in LNG (liquefied natural gas) facilities. Volume 1. Design principles. Final report, August 1983-October 1985. Fecht, B.A.; Rideout, T.B.; Rankin, W.L.; Barnes, V.E.; Saari, L.M. (Pacific Northwest Labs., Richland, WA (USA)). Oct 1985. 148p. (REPT—2311205871). NTIS, PC A07/MF A01.

The principal objectives of this project were to: (1) develop HF design guidelines for computer-aided control and display systems in LNG facilities, and (2) assist the GRI in disseminating project results and developing industry-standard guidelines. A comprehensive collection of state-of-the-art HF guidelines were developed for the workspace, data display, operator-computer dialogue, data entry, annunciator systems and support systems. Examples illustrate HF enhancements resulting from the application of these guidelines. A guideline and checklist package was also developed for use as a practical handbook by the industry when evaluating or improving control and display systems. The package of design and enhancement principles is intended for use by plant operators in evaluating control and display systems and making recommendations for systems improvements, by plant managers in ensuring that HF considerations are incorporated in computer-aided plant systems, and by engineers and equipment vendors in designing equipment and adapting control and display systems to LNG facilities.

33731 (SRD-R—314) Analysis of a 100 te propane storage vessel. Smith, T.A. (UKAEA Safety and Reliability Directorate, Culcheth). Mar 1986. 55p. United Kingdom Atomic Energy Authority, Wigshaw Lone, Culcheth Warrington, Waz 4NE. File Number TI86901413.

The object of this report is to review the possibility of cold whole vessel failure, and establish whether a leak-before-break condition is more likely than catastrophic failure. Changes in design code requirements are examined. Stress levels are calculated using the approaches given in BS 5500:1982 and factors affecting stress levels are discussed. Fracture mechanics concepts are used to calculate critical, or tolerable, crack sizes. The beneficial effects of stress relief are emphasised. 17 refs., 14 figs., 2 tabs.

04 OIL SHALES AND TAR SANDS

0401 Reserves And Exploration

33732 (DOE/RO/00100—T1) Oil shale commercialization study. Warner, M.M. (Boise State Univ., ID (USA)). Sep 1981. Contract FG06-80R000100. 50p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86010569.

Ninety four possible oil shale sections in southern Idaho were located and chemically analyzed. Sixty-two of these shales show good promise of possible oil and probable gas potential. Sixty of the potential oil and gas shales represent the Succor Creek Formation of Miocene age in southwestern Idaho. Two of the shales represent Cretaceous formations in eastern Idaho, which should be further investigated to determine their realistic value and areal extent. Samples of the older Mesozonic and paleozoic sections show promise but have not been chemically analyzed and will need greater attention to determine their potential. Geothermal resources are of high potential in Idaho and are important to oil shale prospects. Geothermal conditions raise the geothermal gradient and act as maturing agents to oil shale. They also might be used in the retorting and refining processes. Oil shales at the surface, which appear to have good oil or gas potential should have much higher potential at depth where the geothermal gradient is high. Samples from deep petroleum exploration wells indicate that the succor Creek shales have undergone considerable maturation with depth of burial and should produce gas and possibly oil. Most of Idaho's shales that have been analyzed have a greater potential for gas than for oil but some oil potential is indicated. The Miocene shales of the Succor Creek Formation should be considered as gas and possibly oil source material for the future when technology has been perfectes. 11 refs.

0402 Site Geology And Hydrology

REFER ALSO TO CITATION(S) 33732

0403 Drilling, Fracturing, And Mining

33733 (PB—86-159829/XAB) Development of effective face-ventilation systems for oil-shale mining. Open File report. Brechtel, C.E.; Adam, M.E.; Agapito, J.F.T. (Agapito (J.F.T.) and Associates, Grand Junction, CO (USA)). Oct 1985. 146p. NTIS, PC A07/MF A01.

The project describes the design and testing of large face-ventilation systems for oil-shale mining. A design data base was generated by reviewing general industry practice, oil-shale-industry planning, and technical literature. Conceptual designs for seven different systems were developed and evaluated for suitability. A large, free-standing, jet fan and reversible fan with rigid duct were selected for fabrication and testing.

0404 Oil Production, Recovery, And Refining

REFER ALSO TO CITATION(S) 33555

33734 (DOE/DP/00789—1996) Data acquisition and analysis of occidental vertical modified in situ retorts 7 and 8. Volume I. Technical summary report; Volume II. Technical appendix. Bickel, T.C. (Sandia National Labs., Albuquerque, NM (USA)). May 1984. Contract AC04-76DP00789. 354p. NTIS, PC A16/MF A01; 1; GPO Dep. File Number DE86001079.

Sandia National Laboratories, funded by the United States Department of Energy, participated with Occidental Oil Shale, Inc., in the extensive instrumentation and analyses of vertical modified in situ (VMIS) Retorts 7 and 8. These retorts were commercial size retorts (50 m x 50 m x 75 m) that were processed concurrently at Occidental's Logan Wash site near Debeque, Colorado. Retorts 7 and 8 each contained approx.340,000 tonnes of rubble with post-blast voids of approx.18%. Average shale grade was 71 l/tonne (17.0 gpt). Design conditions of 0.17 m/min SGV (80% air and 20% steam) were maintained throughout the approx.300 days of processing of the retorts. Raw recycle gas was then injected into the retorts for approximately thirty days prior to the quenching of each retort. The extensive array of instrumentation (in situ thermocouples, flow measurement transducers, gas chromatography (GC) equipment and surface process equipment allowed continuous real-time monitoring and analysis of the retorts. Energy balance calculations (using the combined results of the material balance calculations and the thermal data) indicate about 30% of the available energy of the raw kerogen was combusted to produce shale oil, low BTU gas and C_5H_{10}-C_{12} hydrocarbons. The fuel source for the

combustion energy was mostly oil and char (~90%), while gas accounted for the remainder. Oxygen utilization (a measure of how well combustion energy is utilized in the retorting of shale) was 0.35 and 0.33 kg shale retorted/mole O_2 injected for Retorts 7 and 8, respectively. These values of oxygen utilization for Retorts 7 and 8 are comparable to other in situ retorts, but are still below values attained in pilot plant studies of in situ retorting. 25 refs., 50 figs., 17 tabs.

33735 **(DOE/FE/60177—0044) Western Research Institute quarterly technical progress report, July 1985-September 1985.** (Western Research Inst., Laramie, WY (USA)). Nov 1985. Contract FC21-83FE60177. 126p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE86010951.

Progress reports are presented for the following three areas of investigations: oil shale; tar sand; and underground coal gasification. Separate abstracts have been prepared for each section for inclusion in the Energy Data Base.

33736 **(DOE/FE/60177—0045) Three-dimensional combustion test of tar sand triangle material.** Johnson, L.A. Jr. (Western Research Inst., Laramie, WY (USA)). Dec 1985. Contract FC21-83FE60177. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86010926.

In situ recovery technologies for tar sand deposits and heavy oil reservoirs are simulated at the Western Research Institute to develop a technological base for understanding the application of in situ processes to these resources. Wide ranges of process parameters are tested in a one-dimensional tubular reactor system. Three-dimensional process performance is evaluated by testing the most promising operating parameters, as determined in one-dimensional simulations, in consolidated blocks of the field resource. A three-dimensional simulation of forward combustion was conducted on a block of material from the Tar Sand Triangle deposit. Although combustion was established in the block, the maintenance and advancement of the combustion front was not successful. Problems relating to maintaining and advancing the combustion front were analyzed. To overcome these problems, it has been determined that: (1) larger heated area must be established prior to unheated air injection, and (2) continuous monitoring of oxygen in the produced gas must be used to control air injection rates. 2 refs., 5 figs.

33737 **(DOE/MC/21306—2049) Characterization of eastern and low grade oil shales for fluidized bed combustion. Final report.** Bajura, R.A.; Wang, Y.; Zhang, G. (West Virginia Univ., Morgantown (USA). Dept. of Mechanical and Aerospace Engineering). Feb 1986. Contract AC21-84MC21306. 85p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86011094.

Overall objectives of the present task were to generate preliminary process data and to establish a data base for combustion characterization of eastern and/or low-grade oil shales from experimental studies using small, laboratory-scale fluidized bed combustors and cold flow models. The specific aims developed for the program and subsequently attained were as follows: 2-inch Fluidized Bed Retorting Facility for optimization of temperature and residence time and to study influence of steam, nitrogen, and CO_2; 9-inch Twin-bed Retorting Facility for determination of operating conditions for self-sustaining performance on oil shale, and for obtaining preliminary data on the use of the twin-bed facility for gasification of anthracite; 6 x 9-inch Cold-flow Facility for determination of fluidization velocities through multiple plenum chambers, and for examination of the effect of fluidization velocities on the interface between bed and freeboard regions; 4-inch Cold-flow facility for development of a mathematical description of mixing characteristics; and for characterization of effects of horizontal baffles in attaining plug-flow mixing characteristics; Collection and analysis of shale oil involves optimization of collection procedure to maximize yields, and Dean and Stark analyses of process streams. Results are discussed. 29 figs., 11 tabs.

33738 **(UCRL—94493) Results and interpretation of rapid-pyrolysis experiments using the LLNL solid-recycle oil shale retort.** Cena, R.J.; Mallon, R.G. (Lawrence Livermore National Lab., CA (USA)). 1986. Contract W-7405-ENG-48. 26p. (CONF-8604172—2). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86010787.

From 19. annual oil shale symposium; Golden, CO, USA (21 Apr 1986).

Virtually all rapid pyrolysis oil shale retorting processes currently under study utilize some form of hot-solid as the heat carrying medium. The conditions under which rapid retorting is achieved call for rapid mixing of the solid heat carrier and raw shale followed by a 2 to 3 minute soak period during which pyrolysis occurs. Both chemically active and inactive solid heat carriers have been proposed along with a number of processing strategies. To assess the merits of the various processing alternatives, a thorough understanding of the chemistry and physics involved in solid-recycle retorting is required. At Lawrence Livermore National Laboratory we are studying the chemistry and physics of solid-recycle retorting in a 2 ton/day continuous-loop pilot scale facility. We have operated our continuous-loop system, over the past two years, using both a two-stage fluidized bed pyrolyzer and a cascading mixer and gravity bed pyrolyzer, with recycled shale as the heat carrying medium. The majority of runs have used an Anvil Points 24 GPT shale with dolomite and calcite concentrations typical of western oil shale. The quantity and quality of the oil produced under rapid-pyrolysis conditions is of key interest in continuous-loop systems. We have determined oil yields and have characterized the oil in a number of ways under a variety of processing conditions. The effects of product sweep, recycle ratio, retorting temperature and atmosphere have been studied in both pyrolyzers and are reported. The facility provides a unique opportunity to study sulfur and nitrogen chemistry throughout the recycle system. Oxidized shale has been shown to effectively scrub H_2S from the pyrolysis gas, and only trace quantities of SO_2 have been measured from the combustion of recycled shale. Nitric oxides in the combustor effluent have been measured and are discussed. 12 refs., 7 figs., 14 tabs.

33739 **Oil yield losses in non-uniform in situ oil shale retorts.** Tyner, C.E. (In Situ Technologies Division, Sandia National Laboratories, Alburquerque, NM 87185). *In Situ;* 10: No. 1, vp(1986). Contract AC04-76DP00789.

Oil yield losses within an in situ oil shale retort can be categorized as either sweep inefficiencies or local yield losses. It is well established that rubble bed non-uniformities can contribute directly to sweep inefficiencies. However, the high local yield losses observed in recent field tests have suggested that these non-uniformities may also decrease local oil yield through increased oil coking, cracking, and combustion. To distinguish oil yield loss mechanisms caused by non-uniform permeability distributions from those caused by other factors (particle size, grade, or operating conditions), a series of pilot retorting experiments was conducted with permeability contrast as the only experimental variable. In these experiments we observed, as a function of increasing permeability contrast, increasing delays in heating (and thus retorting) within the less-permeable zones. This resulted directly in increased oil combustion and cracking losses (11 to 20% versus 5% for a uniform base condition) due to increased overlap of retorting and combustion fronts. We also observed under these conditions corresponding decreases in thermal efficiency and char utilization. Finally, two-dimensional retort modeling calculations have been completed which agree well with the experimental results and help illuminate the important mechanisms causing increased oil loss. These data, together with analyses from recent field experiments, have demonstrated conclusively that local oil yield losses (not just sweep inefficiencies) can be introduced or worsened solely by permeability contrasts. Conversely, it appears that local yield as well as sweep efficiency may be significantly improved by creating more uniform rubble beds.

33740 **Pressure drops during low void volume combustion retorting of oil shale.** McLendon, T.R. (US Department of Energy, P.O. Box 1189, Laramie, WY 82070). *In Situ;* 10: No. 1, vp(1986).

Stacks of cut oil shale bricks were combustion retorted in a batch, pilot scale sized retort at low void volumes (overall voids ranged from 8.4% to 18.4%). Retort pressure drops increased during retorting at least one order of magnitude. The Ergun equation and Darcy's law have been used by several researchers and organizations as diagnostic tools on oil shale retorts. These equations were tested on the uniformly packed retort reported in this paper to evaluate how well the equations represented the experimental

conditions. Use of the Ergun equation to estimate the average particle size from retort pressure drops gave answers that were only approximately correct. Calculation of retort pressure drops from Darcy's law during retorting at low void volumes will probably give answers that are several times too small. Thermal expansion of the shale during retorting decreases retort permeability greatly and calculation of the decreased permeability is not possible at the present level of technology.

0405 Properties And Composition

REFER ALSO TO CITATION(S) 33737

0407 Health And Safety

33741 (LMF—114, pp 295-299) **Inhalation exposure of rats to oil shale dust and diesel exhaust.** Mauderly, J.L.; Barr, E.B.; Bice, D.E.; Hanson, R.L.; Henderson, R.F.; Jones, R.K.; Pickrell, J.A.; Wolff, R.K. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

A life-span study of rats exposed by inhalation 7 h/day, 5 days/wk to 5 mg/m^3 of raw or spent oil shale dusts, alone or in combination with diesel exhaust at 3.5 mg soot/m^3, has reached the 18-mo point. Results through the first 12 mo are presented. The combined exposures caused increases in cytoplasmic, lysosomal, and oxidant protective enzymes in airway fluid and retarded clearance of inhaled radiolabeled particles. The combination of spent shale + diesel caused an increase in polymorphonuclear leukocytes in airway fluid. Body weight and respiratory function were unaffected. Results suggest both additive and synergistic effects of the inhaled materials. Significant later-occurring effects in rats exposed to single atmospheres may allow better examination of interactions. 5 references, 1 figure, 3 tables.

0409 Waste Research And Management

33742 (DOE/FE/60177—1954) **Examinations of batch and column procedures used to produce a leachate from retorted oil shale.** McGowan, L.J. (Western Research Inst., Laramie, WY (USA)). May 1985. Contract FC21-83FE60177. 62p. NTIS, PC A04/MF A01; GPO Dep. File Number DE86002054.

The primary research objective of this study was to examine test variables inherent to batch and column procedures for their effect on the leachate produced, and to recommend a batch and column procedure for further retorted shale research. Both batch and column tests can give useful leachate data. Batch tests tell us the total material leached which can be related to pile stability, while column tests tell us the rates of release. Both types of information are necessary to make environmental assessments. Specific variables were evaluated through a series of sorption and desorption tests using batch and column procedures. For the sorption experiments an adsorbate solution was prepared of arsenic, selenium, molybdenum and boron and contacted with spent shale in the batch and column procedures. The leachates were then collected and concentration changes were determined. Following the sorption procedure, the shales were leached with distilled-deionized water and the leachates analyzed to determine if the previously adsorbed elements would be leached. For both the column and batch tests, adsorption and desorption were strongly dependent on the shale retorting process and on the solution chemistry of each element. But the degree of adsorption and desorption in the batch test was influenced by the test conditions. Other variables inherent to batch tests should be tested for their effect on leachate quality. These include method of agitation, temperature effects, pH effects and longer contact times. Although the variables tested in the column tests did not significantly affect the leachate quality, other variables in column procedures could. Further research on column procedures is needed. 8 refs., 25 figs., 21 tabs.

05 NUCLEAR FUELS

0503 Mining

33743 (INIS-mf—10104) **Mining Pribram in science and technology. Geomechanics session.** (Ceskoslovenska Vedeckotechnicka Spolecnost, Prague). 1984. 46p. (In Czech and Slovak). (CONF-8410396—). NTIS (US Sales Only), PC A03/MF A01. File Number DE86702169.

From Symposium on mining Pribram in science and technology; Pribram, Czechoslovakia (15 Oct 1984).

The Geomechanics session of the Symposium "Mining Pribram in Science and Technology" held from October 15 to 20, 1984 heard a total of 18 papers dealing with the effects of exploitation on the stability of the surrounding massif and surface, the protection of surface and deep mines, geophysical surveying, the measurement of deformations caused by undermining, the mathematical modelling of surface deformation and various measuring methods and methods of interpreting measured results. 4 papers are included into INIS.

33744 (INIS-mf—10104, pp 25-41) **Mining principles in the situation of Dolni Rozinka Uranium Mines deposit with respect to protection of open pits and mines.** Blaha, F.; Janas, P.; Cimala, Z. (Vedeckovyzkumny Uhelny Ustav, Ostrava, Czechoslovakia; Uranove Doly, Dolni Rozinka, Czechoslovakia. Odstepny Zavod). 1984. (In Czech). NTIS (US Sales Only), PC A03/MF A01. File Number DE86702169. (CONF-8410396—).

From Symposium on mining Pribram in science and technology; Pribram, Czechoslovakia (15 Oct 1984).

Three surface and a network of underground monitoring points were established for assessing the impact of extracting oblique and steep ore zones and veins in the uranium ore deposit at Dolni Rozinka on the surrounding massif and on the earth surface. On the basis of these in-situ measurements and the results of modelling using equivalent materials and mathematical modelling and the evaluation of practical experience in the excavation of mines in this deposit new techniques were designed for protecting installations and buildings from the impacts of mining activities. The distance and size of limit angles of the mining effect were determined which allowed to considerably limit the range of existing safety pillars and thereby to reduce the volume of utility minerals whose excavation had previously been restricted.

33745 (INIS-mf—10104, pp 75-85) **Effect of indirect softening processes on surface stability in Pribram uranium deposit.** Ruzicka, J. (Uranove Doly, Pribram, Czechoslovakia. Odstepny Zavod). 1984. (In Czech). NTIS (US Sales Only), PC A03/MF A01. File Number DE86702169. (CONF-8410396—).

From Symposium on mining Pribram in science and technology; Pribram, Czechoslovakia (15 Oct 1984).

The Pribram uranium deposit belongs among the hydrothermal vein type deposits and is located in solid rock formations. Indirect concentration reducing processes over the past twenty years have in a number of deposits resulted in the deformation of the surface. A brief analysis is presented of the problem of underground cavities and reactions of the massif and the mechanism is discussed of indirect concentration reducing processes and the usual procedures given in the calculation of the magnitude of surface deformations. On the basis of experiences and geomechanical surveys in the Pribram deposit the method was developed of computing the effect of mining on the surface. The procedure of the computation consists in the distribution of vein nodes into groups of veins, the preparation and processing of input data, identification of coefficients of rock softening and actual computation. The computation proceeds in four stages: the computation of the volume deficit, the computation of the volume reduction, the computation of the size and range of deformations. The computation of this surface deformation will serve as the basis for physical planning after the mine has been excavated.

33746 (INIS-mf—10104, pp 155-161) **Diagnostics of physical condition of rocks with ultrasonic methods.** Taraba, O.; Plocek, J. (Ceske Vysoke Uceni Technicke, Prague, Czechoslovakia. Fakulta Elektrotechnicka). 1984. (In Czech). NTIS (US Sales Only), PC A03/MF A01. File Number DE86702169. (CONF-8410396—).

From Symposium on mining Pribram in science and technology; Pribram, Czechoslovakia (15 Oct 1984).

Electronic systems are described which have been developed for the in-situ measurement of the physical state of rocks with the aim of providing a timely diagnosis of the decomposition of rocks and the prognosis of mine caving. The equipment allows to monitor the time course of the attenuation of ultrasound waves into the rock, measuring the phases of ultrasound waves propagated through the rock and the number of passages of the phase of the wave through the reference value. The device is provided with piezoceramic transducers 32 mm in diameter for measuring in boreholes with a maximum depth of 4 m, and partly filled with water. The natural frequency is 39 kHz, the transmitted acoustic power is 0.1 W, power sensitivity on the receiving side is ca 10^{-17} W and the noise waveband of the receiver is ca 1 kHz. On the basis of experience new transducers were developed and an electronic device allowing measurement to be made in the usual conditions in depths of around 1000 m in shallow and narrow boreholes up to 4 m and for measuring in ca 50 m perpendicular boreholes excavated from the surface downwards for monitoring fills.

33747 (INIS-mf—10104, pp 181-191) **Methods of assessing coefficients of rock softening at Pribram uranium deposit.** Svatos, J.; Ruzicka, J. (Uranove Doly, Pribram, Czechoslovakia. Odstepny Zavod). 1984. (In Czech). NTIS (US Sales Only), PC A03/MF A01. File Number DE86702169. (CONF-8410396—).

From Symposium on mining Pribram in science and technology; Pribram, Czechoslovakia (15 Oct 1984).

A wide range of methods were tried for identifying the coefficients of rock softening important for the computation of the effects of exploitation activities and for the solution of other geomechanical problems, this both in laboratory and on site conditions. The values of the coefficient of permanent softening are highly variable, this mainly in dependence on the petrographic type of fill and on depth of deposition (pressure conditions). Of the testing methods the method of comparing volume density, the method of comparing the widths of stopes and measuring in the testing stope proved to be best. In order to identify the coefficient of the immediate softening of the bulk fill the method was tested of measuring in mine carts, in stopes and in the test stope. In order to calculate the effect of exploitation on the surface it is necessary to know the coefficient of immediate total rock softening and for the calculation of the ceiling of direct concentration reducing processes and the effect of sunken cavities on surface stability it is necessary to know the coefficient of mean softening. Formulas are given for the calculation.

0504 Feed Processing

33748 (INIS-BR—461, pp 78-84) **Uranium isotope analysis.** Santos, G.R. dos; Goncalves, Z.C.; Silva, A.G. da. 1984. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. File Number DE86702106.

In Annual technical report of Nuclear Engineering Institute - Physics Department - 1984.

33749 (K/TS—11-703) **Laser-induced breakdown of UF_6 and its application to flow diagnostics.** Allison, S.W.; Cates, M.R.; Noel, B.W. (Oak Ridge Gaseous Diffusion Plant, TN (USA); Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36;AC05-84OT21400. 3p. (CONF-851185—19). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011408.

From International laser science conference; Dallas, TX, USA (18 Nov 1985).

Breakdown of gaseous UF_6 can be produced with relatively low-fluence (approximately 10^6 W/cm^2) near-uv pulsed laser light. A broad spectrum is produced consisting of hundreds of atomic (U/sub I/ and U/sub II/) lines. Following breakdown, particles are formed from the dissociation/ionization products and the sample volume remains ionized for a long time. This sample volume is elevated in temperature, and a shock wave is produced. Other pertinent details are presented. A schlieren technique is described for observing the motion, hence velocity, of the temperature defect and shock wave. Also given is a flow visualization method based on imaging a long-lived emission component with a gated (>= 10 ns) image intensifier system. These and other methods are prospective ways to perform flow diagnostics in gas centrifuges.

33750 (KAERI/AR—252/84) **Study of UF_4 preparations.** Chang, I.S.; Doh, J.B.; Choi, Y.D. (Korea Advanced Energy Research Inst., Daeduk (Republic of Korea)). May 1985. 59p. (In Korean). NTIS (US Sales Only), PC A04/MF A01. File Number DE86702166.

Uranium tetrafluoride (UF_4), green salt, is a very important intermediate in the production of metallic uranium and uranium hexafluoride (UF_6) for enrichment. The hydrofluorination of uranium dioxide (UO_2) with anhydrous hydrogen fluoride (HF), produced from ADU (ammonium diuranate) process or AUC (ammonium uranyl carbonate) process, are commercially used for the production of uranium tetrafluoride. At present, a new approach such as direct UF_4 preparation at the mine-site without further precipitation, filteration and drying of yellow cake from leaching solution has been studied. The single step continous reduction of uranium hexafluoride to uranium tetrafluoride is one of the most interesting processes being applied for the commercial use of a large amount of depleted UF_6 which is produced in tail after enrichment. The direct conversion of UF_6 and UF_4 with hydrogen and fluorine gases using cold wall reactor has a certain advantage over various wet processes such as AUD and AUC processes in which hydrolysis of UF_6 and various kinds of chemicals are required, including liquid waste treatment. This report reviews and analyzes the theory and processes being used commercially or under study.

33751 (PB—86-158789/XAB) **Development of environmentally attractive leachants. Volume 4. A minitest of an in situ uranium leach solution. Open File report, 5 June 1978-31 July 1984.** Schechter, R.S.; Lake, L.W.; Guilinger, T.R.; Price, J.G.; Bobeck, P. (Texas Univ., Austin (USA). Dept. of Petroleum Engineering). 9 Jul 1985. 151p. NTIS, PC A08/MF A01.

A minitest of the new potassium chloride-potassium carbonate two-stage in situ uranium leach process was carried out at the Intercontinental Energy Corp. Zamzow project site in south Texas. Substantial quantities of high-concentration uranium were produced, indicating the viability of the leach solution. The test results yield information regarding the reservoir dispersivity, the average cation-exchange capacity of the formation, and the distribution coefficients describing cation-exchange reactions. The test also indicates permeability anisotropy and the existence of disturbed flow fields.

0505 Enrichment

33752 (K/OA—5787) **Computer extended series for a thermally driven gas centrifuge.** Berger, M.H. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 3 Jun 1986. Contract AC05-84OT21400. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011147.

Linear multidimensional thermally driven flow in a gas centrifuge can be approximately described away from the ends by Onsager's homogeneous pancake equation. Upon reformulating the general problem we find a new simple and rigorous closed form, analytical solution by assuming a "special" separable solution and replacing the usual Ekman end cap boundary conditions with idealized impermeable, free slip boundary conditions. Then the flow is described by an ode with solutions in terms of simple, "classical" functions. By identifying a small parameter, say ϵ, we define a semi-long bowl approximation, assume a power series expansion in ϵ and produce a sequence of asymptotic approximations to the master potential. Not surprisingly the leading order term involves the well known "long bowl" solution. Using the so-called "solving" property of the 1-D pancake Green's function we determine the next

higher order solution. This recursive process is carried out on the computer to find all the terms up to $O(\epsilon^4)$.

33753 Uranium enrichment: heading for the abyss. Norman, C. *Science (Washington, D.C.);* **221**: 730-733(19 Aug 1983).

This article discusses the federal government's $2.3 billion a year business enriching uranium for nuclear power plants which is heading toward a major crisis. Due to miscalculations by the Department of Energy, it is caught with billions of dollars of construction in progress just as projected demand for enriched uranium is decreasing. At the center of the controversy is the Gas Centrifuge Plant at Portsmouth, Ohio - estimated to cost $10 billion dollars. A review of how DOE got into this situation and how they plan to solve it is presented.

0507 Fuels Production And Properties

REFER ALSO TO CITATION(S) 33783, 33866, 33868, 34305, 34338

33754 (KAERI/AR—251/85) Chemical analysis on post-irradiation examination of nuclear fuels. Cho, K.S.; Eum, T.Y.; Han, S.H.; Kim, J.K. (Korea Advanced Energy Research Inst., Daeduk (Republic of Korea)). Mar 1985. 107p. (In Korean). NTIS (US Sales Only), PC A06/MF A01. File Number DE86702161.

This review describes the techniques used in chemical analysis of irradiated nuclear fuels. Pretreatment of samples containing UO_2 and PuO_2 prior to analysis was reviewed. Chemical methods such as ^{235}U depletion, ^{148}Nd monitoring and γ-spectrometry were also reviewed in detail for the burn-up measurement. Various separation procedures of fission products before determination of individual element were fully described. For the fission gas analysis, gas collection system, volume measurement, and methods of determination by gas chromatography and mass spectrometry were also reviewed. Techniques for the determination of ^{129}I by γ-counting method, mass spectrometry and neutron activation analysis were thoroughly reviewed. Method for boron-heavy water and tritium analysis were reviewed briefly.

33755 Automated manufacturing of breeder reactor fuel. Nyman, D.H.; Benson, E.M.; Bennett, D.W. (Westinghouse Hanford Co., Richland, WA). pp 29-35 of Computer applications in health physics. Kathren, R.L.; Higby, D.P.; McKinney, M.A. Richland, WA; Health Physics Society (1984). (CONF-840202—).

From 17. midyear topical meeting of the Health Physics Society; Pasco, WA, USA (5 Feb 1984).

The Secure Automated Fabrication (SAF) line is an automated, remotely controlled breeder fuel pin fabrication process which is to be installed in the Fuels and Materials Examination Facility (FMEF). The FMEF is presently under construction at Hanford and is scheduled for completion in 1984. The SAF line is scheduled for startup in 1987 and will produce mixed uranium-plutonium oxide fuel pins for the Fast Flux Test Facility (FFTF). Radiological protection requirements, computer control equipment, use of robotics, and the fabrication process is described.

33756 Modeling cesium behavior in nuclear reactor fuels at high temperatures. Schumacher, G.; Wright, S.A. (Sandia National Labs., Albuquerque, NM). pp 197-198 of IUPAC conference on chemical thermodynamics. Hamilton, Ontario; McMaster University (1984). (CONF-840807—). Contract AC04-76DP00789.

From Conference on chemical thermodynamics and 39. calorimetry conference; Hamilton, Canada (13 Aug 1984).

Cesium exerts an important influence on the steady-state and transient behavior of nuclear reactor fuel because of its large fission yield and high volatility. Recent experiments have shown that the release of cesium coincides with the disruptive behavior of rapidly heated fuel. This report describes investigations of the pressure buildup of cesium in fuel pores during fast power transients. A model was developed which estimates the pressure of cesium in the pores as a function of temperature and oxygen-to-metal ratio of the fuel. The model first calculates the oxygen-to-metal ratio in the fuel as a function of the radius for the steady-state preirradiation. This is then used to calculate the oxygen potential for cesium and its compounds as a function of radius and fuel temperature. The model then checks whether cesium is present in the metallic state or in a compound, and then it calculates the corresponding pressure using the appropriate chemical potentials and the equation of state. The results show that cesium has a higher potential than xenon for pressure buildup at temperatures near the melting temperature of the fuel. There are, however, open questions which concern the kinetics of the cesium release to the pores, the chemical stability of the cesium compounds, and the microscopic distribution of the cesium.

0508 Spent Fuels Reprocessing

REFER ALSO TO CITATION(S) 33829, 33869, 34281

33757 (CEA-CONF—8268) Balance and behavior of gaseous radionuclides released during initial fast reactor fuel reprocessing operations. Leudet, A.; Goumondy, J.P.; Charrier, G. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI)). Oct 1985. 15p. (In French). NTIS (US Sales Only), PC A02/MF A01. File Number DE86751885.

Five pins from the fast reactor Phenix are cut and dissolved in a specially designed cell for the accurate determination of gas released during the operation. Amount and activity of gaseous radionuclides: Kr, Xe, Kr-85, I, I-129, H-3 and C-14 are determined in the fuel pins and also their distribution between shearing and dissolution.

33758 (ORNL/TM—9803) User's manual for PUTZ: a point-kernel photon shielding code. Ingersoll, D.T. (Oak Ridge National Lab., TN (USA)). May 1986. Contract AC05-84OR21400. 57p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86011360.

A photon shielding code based on the point-kernel method has been developed. The code, entitled PUTZ, allows the specification of three-dimensional source and body geometries using simple parallelepipeds and annular parallelepipeds, and permits the inclusion of multiple sources and multiple detectors in a single case. A flexible free-form type input format is used, and attenuation data and material buildup factors are contained within the code for selected materials. Versions of the code are available for running on an IBM mainframe computer and an IBM-PC microcomputer (or compatible). A comprehensive user's manual is provided, which describes the basic algorithms, input requirements, output listings, and major limitations.

33759 Design of remote sampling cubicles. Harrington, C.L. (Ralph M. Parsons Co., Pasadena, CA). *Transactions of the American Nuclear Society;* **50**: 594(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

The analytical facilities at the Idaho Chemical Processing Plant (ICPP) were originally constructed in 1955 to support nuclear fuel reprocessing operations. Future operations will result in increased samples from liquid process streams. These streams will possess high radioactivity and require rapid sample analysis. The existing Remote Analytical Facility at the ICPP could not accommodate the increased number of samples, their increased activity, or allow rapid analytical techniques. The new remote sampling cubicles designed for the ICPP provide upgraded samplers, increased shielding, and a rapid transfer system to the newly constructed Remote Analytical Laboratory (RAL). At the RAL, the samples will be studied using state-of-the-art instrumentation and analysis techniques.

33760 Remote maintenance at the UP3 reprocessing plant. Chenevier, F.; Bernar, D.; Richter, R. *Transactions of the American Nuclear Society;* **50**: 596(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

The design of the UP3 reprocessing plant which will be in operation in 1988 ensures plant availability through remote maintenance of all equipment where necessary, especially through the use of a mobile equipment replacement cask (MERC). Two types of MERC were developed: a) the sliding hatch MERC for large standard process equipment and solid waste drums, and b) the revolving MERC for smaller equipment. The use of the MERCs constitutes an innovative approach compared to existing plants. This maintenance concept provides advantages with respect to waste management by limiting the waste produced from the maintenance operations to discarded equipment, thus reducing secondary waste.

0509 Transport And Storage

REFER ALSO TO CITATION(S) 34511, 34516, 34527, 34528, 34529

33761 (DOE/AL/33218—T4) Route-specific analysis for radioactive materials transportation. (Western Interstate Energy Board, Denver, CO (USA)). [1986]. Contract AC02-85AL33218. 323p. NTIS, PC A14/MF A01; 1; GPO Dep. File Number DE86010762.

This report addresses a methodology for route-specific analysis, of which route-selection is one aspect. Identification and mitigation of specific hazards along a chosen route is another important facet of route-specific analysis. Route-selection and route-specific mitigation are two tools to be used in minimizing the risk of radioactive materials transportation and promoting public confidence. Other tools exist to improve the safety of transportation under the Nuclear Waste Policy Act. Selection of a transportation mode and other, non-route-specific measures, such as improved driver training and improved cask designs, are additional tools to minimize transportation risk and promote public confidence. This report addresses the route-specific analysis tool and does not attempt to evaluate its relative usefulness as compared to other available tools. This report represents a preliminary attempt to develop a route-specific analysis methodlogy. The Western Interstate Energy Board High-Level Waste Committee has formed a Route-Specific Analysis Task Force which will build upon the methodology proposed in this Staff Report. As western states continue to investigate route-specific analysis issues, it is expected that the methodology will evolve into a more refined product representing the views of a larger group of interested parties in the West.

33762 (PNL—5714) WASTES II: Waste System Transportation and Economic Simulation. Version II. User's guide. Shay, M.R.; Buxbaum, M.E. (Pacific Northwest Labs., Richland, WA (USA)). Feb 1986. Contract AC06-76RL01830. 107p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE86011018.

The WASTES II model was developed to provide detailed analyses beyond the capabilities of other available models. WASTES uses discrete event simulation techniques to model the generation of commercial spent nuclear fuel, the buildup of spent fuel inventories within the system, and the transportation requirements for the movement of radioactive waste throughout the system. The model is written in FORTRAN 77 as an extension to the SLAM commercial simulation language package. In addition to the pool storage and dry storage located at the reactors, the WASTES model provides a choice of up to ten other storage facilities of four different types. The simulation performed by WASTES may be controlled by a combination of source- and/or destination-controlled transfers that are requested by the code user. The user supplies shipping cask characteristics for truck or rail shipment casks. As part of the facility description, the user specifies which casks the facility can use. Shipments within the system can be user specified to occur optimally, or proximally. Optimized shipping can be used when exactly two destination facilities of the same facility type are open for receipt of fuel. Optimized shipping selects source/destination pairs so that the total shipping distance or total shipping costs in a given year are minimized when both facilities are fully utilized. Proximity shipping sequentially fills the closest facility to the source according to the shipment priorities without regard for the total annual shipments. This results in sub-optimal routing of waste material but can be used to approximate an optimal shipping strategy when more than two facilities of the same type are available to receive waste. WASTES is currently able to analyze each of the commercial spent fuel logistics scenarios specified in the 1985 DOE Mission Plan.

33763 Considerations for the transportation of spent fuel. Jefferson, R.M. (Transportation Tech. Center, Sandia National Laboratories). pp 105-117 of Nuclear power in the Midwest. Chicago, IL; Energy Resources Center, University of Illinois (1984). (CONF-8410315—).

From 12. annual Illinois energy conference; Chicago, IL, USA (31 Oct 1984).

In our society today the transportation of radioactive materials, and most particularly spent reactor fuel, is surrounded by considerable emotion and a wealth of information, good and bad. The transportation of these materials is viewed as unique and distinct from the transportation of other hazardous materials and as a particularly vulnerable component of the nuclear power activities of this nation. Added to this is the concept, widely held, that almost everyone is an expert on the transportation of radioactive materials. One significant contribution to this level of emotion is the notion that all roads (rail and highway), on which these goods will be transported, somehow traverse everyone's backyard. The issue of the transportation of spent fuel has thus become a political battleground. Perhaps this should not be surprising since it has all of the right characteristics for such politicization in that it is pervasive, emotional, and visible. In order that those involved in the discussion of this activity might be able to reach some rational conclusions, this paper offers some background information which might be useful to a broad range of individuals in developing their own perspectives. The intent is to address the safety of transporting spent fuel from a technical standpoint without the emotional content which is frequently a part of this argument.

0510 Marketing And Economics

REFER ALSO TO CITATION(S) 33753

0520 Waste Management

REFER ALSO TO CITATION(S) 33848, 33850, 33851, 33852, 33853, 33854, 33856, 33857, 33858, 33859, 33861, 33863, 33864, 33865, 33867, 34035, 34278, 34285, 34288, 34317, 34351, 34352, 34353, 34354, 34355, 34356, 34419, 34488, 34813, 34858, 34859, 34997, 34998, 34999, 35000, 35001, 35002, 35003, 35005, 35318

33764 (CEA-CONF—8213) Filtration of gaseous wastes released in a furnaces for melting contaminated metals. Andrieux, C.; Daniel, F.; Vendel, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Oct 1985. 11p. (In French). NTIS (US Sales Only), PC A02/MF A01. File Number DE86751886.

Volume reduction, transformation of surface contamination into volume contamination and eventually decontamination by inclusion of radionuclides in the slag are obtained by melting contaminated metallic wastes. Melting is realized in an induction furnace placed in a ventilated cell. Filtration of the gaseous wastes from the furnace is required to protect the filtration system of the cell. The size of aerosols produced during the melting of different metals (Al, Fe, Cu) is below one micron and the quantity varies between 0.05 g to 3 g per hour and per kilogram of molten metal. Optimization of prefiltration is examined.

33765 (DOE/DP/48017—T1) Evaluation of commercial repository capacity for the disposal of defense high-level waste. Comments and responses for DOE/DP—0020. (Mitre Corp., McLean, VA (USA). METREK Div.; USDOE Assistant Secretary for Defense Programs, Washington, DC. Office of the Deputy Assistant Secretary for Nuclear Materials). Dec 1985. Contract AC01-83DP48017. 288p. NTIS, PC A13/MF A01; 1; GPO Dep. File Number DE86010377.

The Nuclear Waste Policy Act of 1982 (Public Law 97-425) requires that the President evaluate the use of disposal capacity at one or more repositories to be developed for permanent disposal of civilian spent nuclear fuel and high-level radioactive waste for the

disposal of defense high-level radioactive waste. The Department of Energy prepared a report titled "An Evaluation of Commercial Repository Capacity for the Disposal of Defense High-Level Waste," DOE/DP-0020, to provide input for the President's evaluation. The report constituted the Department's input and recommendation to be considered by the President in making his evaluation. Although not required by the Act, the Department made the July 1984 draft of the report available to the general public for review and comment in order to increase public awareness, and develop a public record on the issue of disposal of defense high-level waste. Over 400 copies of the draft report were distributed. Thirty comment letters containing over 400 comments were received from representatives of states, localities, and Indian tribes, federal agencies, organizations representing utilities, public interest groups, individual utilities, and private citizens. All letters were reviewed and considered. Where appropriate, changes were made in the final report reflecting the comments received.

33766 **(DOE/OR/20722—96) Maywood interim storage site. Annual site environmental report, calendar year 1985.** (Bechtel National, Inc., Oak Ridge, TN (USA). Advanced Technology Div.). May 1986. Contract AC05-81OR20722. 67p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86010596.

During 1985, the environmental monitoring program was continued at the Maywood Interim Storage Site (MISS), a US Department of Energy (DOE) facility located in the Borough of Maywood and the Township of Rochelle Park, New Jersey. The MISS is presently used for the storage of low-level radioactively contaminated soils. Monitoring results show that the MISS is in compliance with DOE concentration guides and radiation protection standards. Derived Concentration Guides (DCGs) represent the concentrations of radionuclides in air or water that would limit the radiation dose to 100 mrem/yr. The applicable guides have been revised since the 1984 environmental monitoring report was published. The guides applied in 1984 were based on a radiation protection standard of 500 mrem/yr; the guides applied for 1985 are based on a standard of 100 mrem/yr.

33767 **(DOE/OR/21496—3) Radioactive waste management-colloidal adsorption of cations and anions. Technical progress report (semiannual), September 30, 1985-March 31, 1986.** Balam, B.S. (Mississippi Valley State Univ., Itta Bena). Apr 1986. Contract FG05-84OR21496. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010917.

The surface adsorption characteristics of ion-exchange resins and clay minerals as influenced by the type of colloidal material, activity of ions and the concentration of associated electrolytes are being investigated. Electrodes and dialysis techniques are being used to determine the binding and release characteristics of cations and anions of significance in the radioactive waste management. The results obtained and techniques employed for clay fractionation, colloidal material separation, cation exchange capacity measurement and preparation of monocationic saturated colloidal materials have already been reported. The research work was continued to determine the distribution, mobility and binding characteristics of Montmorillonite and Illite clay materials as affected by the degree of saturation of colloidal adsorption capacity and the presence of electrolytes. Donnan equilibrium systems using Ca:Rb ratios of 90:10, 75:25, 50:50 and 10:90 and electrolyte concentrations corresponding to 0 and 0.2 symmetries were established. The systems were allowed to attain equilibrium as judged by conductivity measurements of the dialyzate. The distribution of cations at equilibrium was calculated from ion selective electrode and spectrophotometric measurements.

33768 **(EGG-WM—6962) EG and G hazardous, radioactive mixed and special hazardous waste streams.** Nishimoto, D.D. (EG and G Idaho, Inc., Idaho Falls (USA)). Sep 1985. Contract AC07-76ID01570. 54p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86011029.

This report provides updated lists of EG & G-generated hazardous, radioactive mixed, and special hazardous waste streams. EG & G activities at the various INEL and in-town facilities are reviewed, specifically those activities currently generating hazardous and/or radioactive mixed wastes. These identified wastes are described separately in tabular form where information such as composition, generation rate, and EPA hazardous waste designation are also included. The updated information dealing with EG & G's special hazardous waste is presented in a storage inventory list. The storage location, quantity, packaging, and present status of each waste are provided, if known. Finally, the EG & G inactive disposal (or CERCLA) sites, suspected or known to contain hazardous or radioactive mixed wastes, are identified and characterized as completely as possible. These inactive disposal sites are included because they may prove to be additional sources of either hazardous or radioactive mixed wastes when remedial cleanup activities are initiated.

33769 **(EGG-WM—7168) Hazardous waste program 1985 annual report.** (EG and G Idaho, Inc., Idaho Falls (USA)). Apr 1986. Contract AC07-76ID01570. 50p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86011033.

This report describes the annual status of the Hazardous Waste Program at EG and G Idaho, Inc., for CY 1985. Topics covered include: (a) a summary of the year's significant events and/or accomplishments, (b) the current compliance status of EG & G-operated hazardous waste management facilities, (c) updated information on all hazardous and PCB-contaminated wastes generated by EG & G facilities, and (d) descriptions of the Program's major activities. The INEL's 1985 Biennial Hazardous Waste Report to the EPA is also provided.

33770 **(EGG-WM—7175) Waste characterization and analysis activities conducted in support of the Solidification Development Program at the Idaho National Engineering Laboratory.** Boehmer, A.M. (EG and G Idaho, Inc., Idaho Falls (USA)). Mar 1986. Contract AC07-76ID01570. 106p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE86011046.

EG & G Idaho Inc., has initiated a program to develop safe, efficient, cost-effective solidification treatment methods for the disposal of some of the hazardous and mixed wastes generated at the INEL. An integral part of the solidification program is the identification and evaluation of waste streams. The results of the waste characterization and analysis activity, conducted in support of the solidification development, are presented in this report.

33771 **(EGG-WM—7225) Hazardous and mixed waste solidification development conducted at the Idaho National Engineering Laboratory.** Boehmer, A.M.; Larsen, M.M. (EG and G Idaho, Inc., Idaho Falls (USA)). Apr 1986. Contract AC07-76ID01570. 89p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86011031.

EG & G Idaho, Inc., has initiated a program to develop safe, efficient, cost-effective solidification treatment methods for the disposal of some of the hazardous and mixed wastes generated at the Idaho National Engineering Laboratory (INEL). Testing has shown that Extraction Procedure (EP) toxic wastes can be successfully solidified using cement, cement-silicate, or ENVIROSTONE binders to produce nontoxic stable waste forms for safe, long-term disposal as general or low-level waste, depending upon the radioactivity. The results of the solidification development program are presented in this report.

33772 **(EWE—2552.01) Survey of stores for conditioned intermediate and low level wastes in Europe.** (Electrowatt Engineering Services Ltd., Horsham (UK); Department of the Environment, London (UK)). Oct 1985. 70p. NTIS (US Sales Only), PC A04/MF A01. File Number DE86702197.

A survey has been conducted of eleven waste storage facilities in six countries. Wastes considered are intermediate and low level, conditioned for disposal. Civil engineering, handling facilities, container type, waste activities, doses to the public and to operators are considered.

33773 (GAO/RCED—86-86) **Nuclear waste. Quarterly report on DOE's Nuclear Waste Program as of December 31, 1985.** (General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div.). Jan 1986. 48p. General Accounting Office, Box 6015, Gaithersburg, MD 20877. File Number TI86901395.

Report to Congressional Requesters.

This report provides the status of the Department of Energy's implementation of the Nuclear Waste Policy Act of 1982 for the quarter ending December 31, 1985. It discusses the Department's progress in meeting legislated deadlines, summarizes the status of the Nuclear Waste Fund, and discusses management initiatives and federal relations with states and Indian tribes. The program has made progress towards meeting the act's requirements, but continues to lag behind legislated and DOE-imposed deadlines for such activities as the issuance of first repository final environmental assessments. Events related to requirements of the act that occurred during the quarter included issuance of a draft monitored retrievable storage facility proposal and a draft Area Recommendation Report for the second repository. One new lawsuit was filed concerning the nuclear waste program, and decisions against DOE were handed down on two of the previously filed suits. Management initiatives during the quarter included the completion of a Program Management System manual, which defines the policies and procedures for a cohesive and cost-effective program. DOE also continued to monitor its contracted audits of the waste program and initiated its own audit of the program. In addition, DOE continued its efforts to inform states and tribes of program developments. As of December 31, 1985, the Nuclear Waste Fund had a balance of about $1.6 billion, most of which has been invested in Treasury bills and notes.

33774 (GEND—041) **Calculational technique to predict combustible gas generation in sealed radioactive waste containers.** Flaherty, J.E.; Fujita, A.; Deltete, C.P.; Quinn, G.J. (EG and G Idaho, Inc., Idaho Falls (USA)). May 1986. Contract AC07-76ID01570. 69p. NTIS, PC A04/MF A01; GPO Dep. File Number DE86011395.

Certain forms of nuclear waste, when subjected to ionizing radiation, produce combustible mixtures of gases. The production of these gases in sealed radioactive waste containers represents a significant safety concern for the handling, shipment and storage of waste. The US Nuclear Regulatory Commission (NRC) acted on this safety concern in September 1984 by publishing an information notice requiring waste generators to demonstrate, by tests or measurements, that combustible mixtures of gases are not present in radioactive waste shipments; otherwise the waste must be vented within 10 days of shipping. A task force, formed by the Edison Electric Institute to evaluate these NRC requirements, developed a calculational method to quantify hydrogen gas generation in sealed containers. This report presents the calculational method along with comparisons to actual measured hydrogen concentrations from EPICOR II liners, vented during their preparation for shipment. As a result of this, the NRC recently altered certain waste shipment Certificates-Of-Compliance to allow calculations, as well as tests and measurements, as acceptable means of determining combustible gas concentration. This modification was due in part to work described herein.

33775 (INIS-BR—461, pp 50) **Storage of radioactive wastes.** Almeida, G.L. de; Costa e Silva, A.; Rautenberg, F.A.; Souza, M.L.M. de. 1984. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. File Number DE86702106.

In Annual technical report of Nuclear Engineering Institute - Physics Department - 1984.

33776 (Juel-Conf—54) **Radioactive waste products - suitability for final disposal. Proceedings.** Merz, E.; Odoj, R.; Warnecke, E. (eds.). (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Chemische Technologie der Nuklearen Entsorgung; Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.)). Jun 1985. 645p. (CONF-8506114—). NTIS (US Sales Only), PC A99/MF A01. File Number DE86752037.

From International seminar on radioactive waste products suitability for final disposal; Julich, F.R. Germany (10 Jun 1985).

48 papers were read at the conference. Separate records are available for all of them. The main problem in radioactive waste disposal was the long-term sealing to prevent pollution of the biosphere. Problems of conditioning, acceptance, and safety measures were discussed. Final disposal models and repositories were presented. (PW).

33777 (Juel-Conf—54, pp 1-16) **Overview of FRG-waste disposal R and D activities.** Hamacher, H.; Merz, E.; Roethemeyer, H. (Bundesministerium fuer Forschung und Technologie, Bonn, Germany, F.R.; Kernforschungsanlage Juelich G.m.b.H., Germany, F.R.; Physikalisch-Technische Bundesanstalt, Braunschweig, Germany, F.R.). Jun 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE86752037. (CONF-8506114—).

From International seminar on radioactive waste products suitability for final disposal; Julich, F.R. Germany (10 Jun 1985).

The conversion of liquid waste arising in the course of spent fuel reprocessing and their conditioning for final disposal have reached an advanced development status. Pilot plant operation has successfully demonstrated the safe handling and suitability of such waste products for final disposal in deep underground repositories. Models are available for predicting the rather unlikely but nevertheless not excludable radionuclide transport between an underground repository and the biosphere via a specified water path. (orig./PW).

33778 (Juel-Conf—54, pp 17-27) **Overview of the DOE waste package program.** Purcell, W.J.; Benz, E.F. (USDOE Office of Civilian Radioactive Waste Management, Washington, DC; Roy F. Weston, Inc., Rockville, MD, USA). Jun 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE86752037. (CONF-8506114—).

From International seminar on radioactive waste products suitability for final disposal; Julich, F.R. Germany (10 Jun 1985).

The U.S. Department of Energy has made significant progress toward the eventual operation of a repository for the disposal of high-level radioactive wastes in the United States. Following the process required by law and regulation, the draft EAs (EAs= environmental assessments) have proposed five sites as potentially suitable for characterization, and identified three preferred sites. Contracts are in place established for acceptance of spent fuel from utilities, and waste acceptance requirements are being developed for high-level wastes from other sources. Waste package conceptual designs have been developed for each of the candidate repository media. (orig./PW).

33779 (Juel-Conf—54, pp 28-36) **Italian Technical Guide on waste management.** De Crescenzo, V.; Eletti, G. Jun 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE86752037. (CONF-8506114—).

From International seminar on radioactive waste products suitability for final disposal; Julich, F.R. Germany (10 Jun 1985).

The Technical Guide identifies and specifies the fundamental criteria and requirements for an appropriate waste management policy. The aim of these criteria is not to formulate a detailed legislation, that is outside the statutory duty of the Italian Regulatory Body, but to establish the general principles against which the acceptability of any waste management proposal is assessed. Throughout the document the wastes are classified into three categories related to different management routes. There is a specific guidance for the first and second categories and same general guidance for the third category which concerns those wastes requiring a confinement time of a thousand years or more. (orig./PW).

33780 (Juel-Conf—54, pp 44-53) **Swedish programme for quality assurance of reactor waste.** Forsstroem, H. (Swedish Nuclear Fuel and Waste Management Co., Stockholm). Jun 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE86752037. (CONF-8506114—).

From International seminar on radioactive waste products suitability for final disposal; Julich, F.R. Germany (10 Jun 1985).

A final repository for reactor waste radwaste is under construction in Sweden. The facility will be taken into operation in 1988. With the construction of it the handling sequence for reactor waste has been completed. It is thus now possible to assess in a sys-

tematic way the requirements on the waste packages in each step of the handling sequence, production-storage-transport-disposal, and the quality control procedure needed to show that the requirements are fulfilled. With the Swedish waste management system as a background, the methodology to perform this assessment is discussed in this paper. (orig./PW).

33781 (Juel-Conf—54, pp 54-62) **Concepts for experimental control of radioactive waste to be disposed of in Switzerland.** Alder, J.C.; Houriet, J.P. (Nationale Genossenschaft zur Lagerung Radioaktiver Abfaelle, NAGRA, Baden, Switzerland; Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen, Switzerland). Jun 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE86752037. (CONF-8506114—).

From International seminar on radioactive waste products suitability for final disposal; Julich, F.R. Germany (10 Jun 1985).

Central topics in the determination of a waste quality assurance programme are the quantitative definition of the parameters to be controlled and the evaluation of appropriate control measures. Recent Swiss work in these areas is reported with emphasis on control requirements derived from long-term safety analyses, and specific attention being paid to radionuclide monitoring issues. The nuclides to be controlled in different waste package types are illustrated and the necessary measuring systems discussed. The project aim is to develop an integrated system checking only parameters of demonstrated relevance and minimising controls at the repository itself.

33782 (Juel-Conf—54, pp 63-76) **Concept and realization of quality control for radioactive waste.** Warnecke, E.; Martens, B.R.; Eigenwillig, G.G.; Odoj, R. (Physikalisch-Technische Bundesanstalt, Braunschweig, Germany, F.R.; Kraftwerk Union A.G., Offenbach am Main, Germany, F.R.; Kernforschungsanlage Juelich G.m.b.H., Germany, F.R.). Jun 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE86752037. (CONF-8506114—).

From International seminar on radioactive waste products suitability for final disposal; Julich, F.R. Germany (10 Jun 1985).

Radioactive waste packages to be disposed of must meet the waste acceptance requirements of the repository. Compliance with the waste acceptance requirements must be checked by a waste package quality control. This paper represents the planning stage in March, 1985. In the very recent past the legal aspects of product control have been discussed with the Federal States particularly the harmonization of product control with the supervision of nuclear facilities by the Federal States and their experts. The results show that it is necessary to check the already existing waste packages with non-destructive or destructive test methods and that it is possible to ensure waste package quality by means of inspection of a qualified and instrumented conditioning process.

33783 (Juel-Conf—54, pp 77-85) **Measures for product control during the treatment of radioactive waste.** Schneider, V.W.; Christ, B.G. (Alpha Chemie und Metallurgie G.m.b.H., ALKEM, Hanau, Germany, F.R.; Transnuklear G.m.b.H., Hanau, Germany, F.R.). Jun 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE86752037. (CONF-8506114—).

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Process control during conditioning of the wastes can be used as a very appropriate measure to perform the task of quality assurance. This contribution aims to outline what such a process control would look like in practice. A number of examples is examined dealing with wastes typically arising during the operation of nuclear power plants and during MOX fuel fabrication. The examples also cover treatment by the waste generator or a hired service company, with stationary or mobile facilities. It is found that the system of process control as introduced by the paper could be adopted for all examples. (orig./PW).

33784 (Juel-Conf—54, pp 97-106) **Development of testing and measurement methods for quality control.** Krischer, W.; Simon, R. (Commission of the European Communities, Brussels, Belgium). Jun 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE86752037. (CONF-8506114—).

From International seminar on radioactive waste products suitability for final disposal; Julich, F.R. Germany (10 Jun 1985).

Correlation of product properties to data measured during the conditioning process has only been investigated for the cementation of waste. For quality assurance to be effective, the accuracy of the measured data must be consistent and commensurate to the tolerances of product quality. Test methods and equipment must therefore be evaluated carefully to be accepted as instruments of quality control. Two test campaigns were carried out to examine the accuracy, sensitivity and reproducibility of measurement methods. NDT (NDT= non-destructive testing) has, in recent years, become a more and more reliable tool for quality control. Sealed waste packages constitute an obvious field of application. The latest NDT-method is the radiographic scanning (X-ray tomography) of waste packages to examine their macroscopic structure.

33785 (Juel-Conf—54, pp 107-132) **Quality checking studies on 210-liter drums containing sealed plutonium sources in a cement matrix.** Lambert, K.P.; Leake, J.W.; Wakefield, G. (UKAEA Atomic Energy Research Establishment, Harwell). Jun 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE86752037. (CONF-8506114—).

From International seminar on radioactive waste products suitability for final disposal; Julich, F.R. Germany (10 Jun 1985).

The paper reports work performed on 210-liter drums of both concrete and simulated soft waste immobilised with a cement grout which contain re-entrant tubes located in a series of radial positions. Sealed plutonium sources were inserted into the re-entrant tubes and the drums subjected to plutonium measurements; comparisons being made between the assay data obtained from the plutonium sources in the empty drums and after filling with concrete and the waste-grout mixture. It is concluded that high resolution gamma spectrometry as implemented on the segmented gamma scanner and both total and coincidence neutron counting are suitable techniques for the quality checking of 210-liter drums of immobilised soft waste; the paper reports detection limits, precision and accuracy for these assay techniques.

33786 (Juel-Conf—54, pp 133-139) **'Waste' instrument for classifying of Pu-contaminated wastes based on passive neutron assay.** Bondar, L.; Girardi, F. (Commission of the European Communities, Ispra, Italy. Joint Research Centre). Jun 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE86752037. (CONF-8506114—).

From International seminar on radioactive waste products suitability for final disposal; Julich, F.R. Germany (10 Jun 1985).

The construction of a 'waste' instrument is in course. It is able to assign waste drums to one of three possible routes; shallow land burial, deep repository, intermediate storage for future recycle. Preliminary experiments have been carried out to clarify construction parameters. The results for the 220 l concrete drum indicate the realizability of the 'waste' instrument.

33787 (Juel-Conf—54, pp 140-152) **Description and performances of non-destructive measurements of alpha radioactive nuclei in waste.** Bernard, P.; Bosser, R.; Frejaville, G. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance, France). Jun 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE86752037. (CONF-8506114—).

From International seminar on radioactive waste products suitabiiity for final disposal; Julich, F.R. Germany (10 Jun 1985).

This paper presents a review of the methods for non-destructive and non-intrusive measurements of wastes. These methods are based on gamma and neutron detection, either in passive or active mode. Principle of methods, uncertainty causes, and evaluation of accuracy are presented.

33788 (Juel-Conf—54, pp 153-163) **Programme for conditioning and intermediate storage of waste from a nuclear research and development center.** Linder, P.; Olsson, G.; Sjoeblom, R. (Studsvik Energiteknik AB, Nykoeping, Sweden). Jun 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE86752037. (CONF-8506114—).

From International seminar on radioactive waste products suitability for final disposal; Julich, F.R. Germany (10 Jun 1985).

The origins of the waste at a nuclear research and development center are described and the variety of waste types is exemplified. A treatment facility has been designed for the production of standard waste packages, that will meet the safety and quality assurance requirements for the treatment, intermediate storage, transportation and final disposal. An example illustrates how a set of requirements can be deduced from an analysis of the different links of the handling chain and how the quality control can be implemented in such a way that the control efforts as much as possible are concentrated on the input materials and the process rather than on the final packages.

33789 (Juel-Conf—54, pp 164-173) **Characterisation for disposal purposes of the total inventory of radioactive wastes arising in Switzerland.** Buchheim, B.; Tunaboylu, K.; Alder, J.C. (Electrowatt Engineering Services Ltd., Zurich, Switzerland; Motor-Columbus Ingenieurunternehmung A.G., Baden, Switzerland; Nationale Genossenschaft zur Lagerung Radioaktiver Abfaelle, NAGRA, Baden, Switzerland). Jun 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE86752037. (CONF-8506114—).

From International seminar on radioactive waste products suitability for final disposal; Julich, F.R. Germany (10 Jun 1985).

To provide the necessary input for the Swiss feasibility study on the safety of waste disposal, extensive characterisation of wastes arising from all sources has been performed. Included in the assmebled database are quantitative descriptions of wastes from fuel reprocessing, reactor operation and decommissioning and from medicinal, research and industrial applications of radioisotopes. The rationale behind the organisation and structure of the data is described, and specific examples are given of areas in which problems were encountered in achieving the appropriate level of waste characterisation for input to safety analyses and to planning of disposal strategies.

33790 (Juel-Conf—54, pp 184-201) **Waste packages and engineered barriers for the Chalk River Nuclear Laboratories disposal program.** Buckley, L.P. Jun 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE86752037. (CONF-8506114—).

From International seminar on radioactive waste products suitability for final disposal; Julich, F.R. Germany (10 Jun 1985).

Open bottom concrete trenches with water-resistant covers will provide the necessary containment for most radionuclides generated from reactor operations. Engineered barriers within these trenches will restrict water movement and curtail radionuclide transport from the waste through the repository to the surrounding biosphere. When wastes which are properly packaged are placed in a repository, the release of radionuclides is diffusion controlled. For a repository located above the water table, where unsaturated groundwater conditions will exist, the waste package should remain stable beyond the period required for the decay of cesium-137 and strontium-90 to innocuous levels. With the combination of engineered barriers and intrusion resistant covers, radionuclides should remain within a shallow land repository.

33791 (Juel-Conf—54, pp 202-225) **Characteristics of low-level radioactive waste in the United States.** Coleman, J.A.; Dodge, R.L. (Department of Energy, Washington, DC, USA; EG and G Idaho, Inc., Idaho Falls, USA). Jun 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE86752037. (CONF-8506114—).

From International seminar on radioactive waste products suitability for final disposal; Julich, F.R. Germany (10 Jun 1985).

Low-level radioactive waste in the U.S. is produced as a result of nuclear power production, research in the biological, chemical, and physical sciences, medical treatment and research, and industrial uses. Additional LLW is produced as a result of defense-related activities of the U.S. Government. Although LLW is produced in a variety of solid, liquid, and gaseous forms, federal, state and disposal site regulations limit the radiological, physical and chemical characteristics of the waste prior to transportation and disposal. All LLW to be disposed of at commercially operated disposal facilities must conform, or be treated to conform, to minimum waste acceptance criteria.

33792 (Juel-Conf—54, pp 226-239) **Characterization of low- and intermediate-level CANDU reactor wastes for disposal.** Williamson, A.S. (Ontario Hydro, Toronto, Canada. Research Div.). Jun 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE86752037. (CONF-8506114—).

From International seminar on radioactive waste products suitability for final disposal; Julich, F.R. Germany (10 Jun 1985).

Low- and intermediate-level CANDU reactor radwastes are being characterized for composition, radiological hazard and conditioning requirements to enable eventual disposal of the wastes in rock caverns or in-ground concrete monoliths. The four main waste classifications are: combustible, compactable, non-processable and ion exchange resin. Studies have determined the radioactivity of incinerable and compactable waste is low and the activity of these wastes decreases considerably within ten years of production. Research is continuing on the characterization of non-processable and ion exchange resin wastes. It is expected suitable packaging is all that will be required for non-processable waste and only ion exchange resins will require sophisticated conditioning treatment because of their relatively high carbon-14 loading.

33793 (Juel-Conf—54, pp 240-254) **Characterization of low- and intermediate level cemented waste forms.** Koester, R.; Vejmelka, P.; Brunner, H.; Ganser, B. (Kernforschungszentrum Karlsruhe G.m.b.H., Germany, F.R.; Nuklear-Chemie und -Metallurgie G.m.b.H., NUKEM, Hanau, Germany, F.R.). Jun 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE86752037. (CONF-8506114—).

From International seminar on radioactive waste products suitability for final disposal; Julich, F.R. Germany (10 Jun 1985).

The main objective of the characterization work was to establish source term formulations for the cemented waste forms as input for safety analysis. For the operation phase of a repository radionuclide mobilization from the waste packages via the gas phase, caused by mechanical or thermal impact has to be considered. For this reason, besides laboratory tests, experiments with inactive full scale samples were performed to determine quantitatively the activity release from the waste packages under defined thermal and mechanical stresses. In order to evaluate source terms for the mobilization of relevant radionuclides via the liquid phase as a function of time due to leaching and corrosion, detailed experimental work with simulated inactive and doped laboratory samples and with inactive full scale samples was performed. The experimental work was accompanied by theoretical investigations to establish an improved basis for long-term predictions.

33794 (Juel-Conf—54, pp 255-265) **Characterization of cement solidification products of reactor wastes generated at the Loviisa nuclear power plant.** Maehoenen, P. (Imatra Power Co. Ltd., Helsinki, Finland). Jun 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE86752037. (CONF-8506114—).

From International seminar on radioactive waste products suitability for final disposal; Julich, F.R. Germany (10 Jun 1985).

The laboratory tests have shown that the wet wastes produced at the Loviisa NPS (NPS = nuclear power station) can be solidified by using cementious materials. According to the test results, the properties of cemented wastes are adequately satisfactory for final disposal. However it is impossible to predict long-term resistance of cemented wastes. The safe disposal must be based on a multi-barrier system, which includes solidification products, strong containers, possible buffer materials, the repository itself and the environment of repository.

33795 (Juel-Conf—54, pp 266-281) **Charcterization of solidified radioactive wastes produced at Montalto di Castro BWR plant with reference to the site storage.** Donato, A.; Ricci, G.; Pace, A. (ENEA, Casaccia, Italy). Jun 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE86752037. (CONF-8506114—).

From International seminar on radioactive waste products suitability for final disposal; Julich, F.R. Germany (10 Jun 1985).

The cement solidification of the Montalto di Castro BWR plant radwastes has been studied both from the point of view of the mixture formulation and of the product characterization. Five radwaste types and mixtures of them have been taken into consideration, determining the best chemical formulations starting from the compressive strength as leading parameter. The solidified products have been characterized from the point of view of the freeze and thawing resistance, the water immersion resistance, the leachability, the dimensional changes and the free standing water. All the tests have been performed taking into account the real site conditions, so the leaching tests and the water immersion tests have been carried out using sea water and table water as leachant.

33796 (Juel-Conf—54, pp 282-290) **Nondestructive techniques for evaluating the integrity of vitrified solids.** Sasaki, Noriaki; Ikeda, Satoshi; Sano, Akira; Uchida, Katsuya; Sugimura, Koji; Matsuda, Kazunori; Murata, Toru; Kakuta, Akio. (Power Reactor and Nuclear Fuel Development Corp., Tokyo, Japan; Nippon Atomic Industry Group Co. Ltd., Tokyo; Toshiba Corp., Tokyo, Japan). Jun 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE86752037. (CONF-8506114—).

From International seminar on radioactive waste products suitability for final disposal; Julich, F.R. Germany (10 Jun 1985).

Measurements by transmission computed tomography, emission computed tomography and transmission-type gamma-scanning were successfully done for full-scale nonradioactive samples, and useful data were obtained. From these results, it was verified that these nondestructive techniques were effective for the inspection of vitrified solids. With some additional theoretical works, it was found that these techniques were applicable to radioactive vitrified solids effectively.

33797 (Juel-Conf—54, pp 291-318) **Producing a high-level radioactive waste form for disposal.** Leclaire, D.B.; Crandall, J.L.; McElroy, J.L.; Pope, J.M. (Department of Energy, Aiken, SC, USA. Defense Waste Processing Facility; Du Pont de Nemours, E.I. and Co., Aiken, SC, USA; Battelle Pacific Northwest Labs., Richland, WA, USA). Jun 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE86752037. (CONF-8506114—).

From International seminar on radioactive waste products suitability for final disposal; Julich, F.R. Germany (10 Jun 1985).

The United States expects to be providing borosilicate glass waste forms from its high level nuclear reprocessing wastes at Savannah River and West Valley before the year 1990. There is also a large and convincing volume of U.S. and international data to demonstrate that these waste forms will have very low releases in geologic disposal, should meet U.S. regulatory requirements, and can be successfully quality controlled. Research on high-level waste forms is still continuing.

33798 (Juel-Conf—54, pp 389-398) **Standardization of waste acceptance test methods by the Materials Characterization Center.** Slate, S.C. (Battelle Pacific Northwest Labs., Richland, WA, USA). Jun 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE86752037. (CONF-8506114—).

From International seminar on radioactive waste products suitability for final disposal; Julich, F.R. Germany (10 Jun 1985).

This paper describes the role of standardized test methods in demonstrating the acceptability of high-level waste forms for disposal. Key waste acceptance tests are standardized by the Materials Characterization Center, which the US DOE has established as the central agency in the United States for the standardization of test methods for nuclear waste materials. This paper describes the basic three-step process that is used to show that waste is acceptable for disposal and discusses how standardized tests are used in this process. Several of the key test methods and their areas of application are described. Finally, future plans are discussed for using standardized tests to show waste acceptance.

33799 (Juel-Conf—54, pp 455-469) **Compatibility between compacted cladding waste and a clay formation.** Regge, P. de; Casteels, F. (Centre d'Etude de l'Energie Nucleaire, Mol, Belgium. Studienzentrum fuer Kernenergie). Jun 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE86752037. (CONF-8506114—).

From International seminar on radioactive waste products suitability for final disposal; Julich, F.R. Germany (10 Jun 1985).

From the experimental data it can be stated that a casing of lead enveloping the waste presents excellent resistance to corrosion in the argillaceous formations considered as a repository for this type of solid nuclear waste. The leach rate of radioisotopes from the compacted material however is lower than the leach rate from embedded material due to the transformations occuring at the zircaloy surface during the embedment operation. The leach rate of actinides is not affected by the presence of the lead matrix. On this basis new developments for the conditioning of the waste, still based on the use of lead alloys are under consideration.

33800 (Juel-Conf—54, pp 470-482) **Interaction between a nuclear glass and nearfield materials in various rigs simulating a geological repository.** Nogues, J.L.; Vernaz, E.; Jacquet-Francillon, N.; Pasquini, S. (CEA Etablissement de la Vallee du Rhone, 30 - Bagnols-sur-Ceze, France; CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance, France). Jun 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE86752037. (CONF-8506114—).

From International seminar on radioactive waste products suitability for final disposal; Julich, F.R. Germany (10 Jun 1985).

Five rigs were set up to simulate various disposal scenarios. Leach tests at 90°C and 10 MPa for 16 months indicated that glass alteration was highly dependent on the environmental material. An attempt was made to determine the chemical composition, the fine structure and crystallinity of the glass block surface layer. Investigations were conducted of the nearfield materials. The results contribute to an understanding of the behavior of these materials in long term disposal, and to detection of the corrosion products which might react with the glass. The overall results provide valuable data on glass alterability under integrally simulated conditions taking into account the major findings obtained in pure water.

33801 (Juel-Conf—54, pp 483-491) **Possibilities of quality assurance on radioactive waste packages by computer tomography and other radiometric techniques.** Kettschau, A.; Goebbels, J.; Reimers, P.; Weise, H.P. (Bundesanstalt fuer Materialpruefung, Berlin, Germany, F.R.). Jun 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE86752037. (CONF-8506114—).

From International seminar on radioactive waste products suitability for final disposal; Julich, F.R. Germany (10 Jun 1985).

It has been shown, that with an industrial computer tomography-system several radiometric measurements can be performed. They reach from simple density examinations, projection images, projection images with comparison of actual and nominal value to tomographic images. Finally it shall be emphasized that the final conditions for the disposal of radioactive wastes have not been defined exactly. Therefore the method cannot be optimized to certain problems. The tomograms can give a lot of information. For example the distribution of cracks can give information about mechanical solidity, about the cooling down process, about damages during transport, the size of the inner surface, the heat conductivity within the glass, the release rates of the radioactive content. The value of these informations and the severity of detected defects depends on the concept of waste disposal.

33802 (Juel-Conf—54, pp 492-496) **EPA's high-level waste standards and waste package performance.** Meyers, S. (Environmental Protection Agency, Washington, DC, USA. Office of Radiation Programs). Jun 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE86752037. (CONF-8506114—).

From International seminar on radioactive waste products suitability for final disposal; Julich, F.R. Germany (10 Jun 1985).

The seven assurance requirements EPA was considering were these: (1) Disposal systems shall not depend on active institutional controls for more than 100 years after disposal; (2) Long-term disposal system performance should be monitored for a reasonable time as a supplement to other types of protection; (3) Disposal systems shall be marked and their locations recorded in all appropriate government records; (4) Disposal systems shall be designed with several different types of barriers, both natural and engineered; (5) Sites should not be located where scarce or easily accessible resources are located; (6) Site selection should consider the relative isolation offered by potential alternatives; and (7) Wastes shall be recoverable for a reasonable time after disposal. (orig./PW).

33803 (Juel-Conf—54, pp 497-511) **Waste acceptance requirements: Procedure and basic data.** Brennecke, P.; Warnecke, E. (Physikalisch-Technische Bundesanstalt, Braunschweig, Germany, F.R.). Jun 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE86752037. (CONF-8506114—).

From International seminar on radioactive waste products suitability for final disposal; Julich, F.R. Germany (10 Jun 1985).

The licensing procedure for the Konrad repository was initiated by the PTB (PTB=Physikalisch-Technische Bundesanstalt) in August 1982. The safety analysis for the operational phase of the disposal mine has meanwhile been supplemented in the plan approval documents which were submitted to the licensing authority in March 1985. At present, the activities of the PTB are focussed on the long-term safety studies in the post-operational phase. These investigations include, inter alia, the results of the exploratory deep drilling Konrad 101. It is possible that additional waste specifications may result from these calculations.

33804 (Juel-Conf—54, pp 512-532) **Requirements on radioactive waste derived from the safety analysis for the repository in the Konrad iron ore mine under normal and incident conditions during the operational phase.** Berg, H.P.; Ehrlich, D.; Illi, H.; Thomauske, B. (Physikalisch-Technische Bundesanstalt, Braunschweig, Germany, F.R.). Jun 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE86752037. (CONF-8506114—).

From International seminar on radioactive waste products suitability for final disposal; Julich, F.R. Germany (10 Jun 1985).

In principle, it can be said that requirements on radioactive waste from the analysis of the operational phase and the post-operational phase exist independently of one another. The present paper is limited to the safety analysis during the operational phase, as complete data of the overall geological situation of the Konrad mine needed for the evaluation of the post-operational phase are not yet available. The comments on the normal operation and on the incidents during the operational phase are based on the work of the 'Gesellschaft fuer Reaktorsicherheit mbH' carried out on request of the Physikalisch-Technische Bundesanstalt Braunschweig, and on this work.

33805 (Juel-Conf—54, pp 552-571) **WIPP TRU Waste Acceptance Criteria - development, application, and quality assurance.** D'Ambrosia, J.T.; Bresson, J.F.; Dieckhoner, J.E. (Department of Energy, Washington, DC, USA). Jun 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE86752037. (CONF-8506114—).

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The Waste Acceptance Criteria which relate to contact-handled transuranium waste fall into four main categories. They are: 1) Waste Form, which includes limits on liquid and particulate content in waste packages; 2) Radiation Protection, which includes limits on fissile material content to prevent inadvertant criticality, the total alpha and plutonium-239 equivalent curies allowed in a package, and the surface dose rate and contamination limits; 3) Container Requirements, which include package size and weight limits; 4) Data and Documentation, which includes waste package color coding and the records of the waste container and contents.

33806 (Juel-Conf—54, pp 572-580) **Low-level radioactive Waste Acceptance Criteria for treatment by high pressure compacting at ECN-Petten.** Vriesema, B.; Bergmans, H. (Commission of the European Communities, Petten, Netherlands. Joint Nuclear Research Center). Jun 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE86752037. (CONF-8506114—).

From International seminar on radioactive waste products suitability for final disposal; Julich, F.R. Germany (10 Jun 1985).

The major part of the solid waste was conditioned by high pressure compaction. Criteria for compacting the drums are received regard: thickness of metal parts in the waste; liquid content; content of elastic materials and distribution of nuclides. Waste not fulfilling these requirements had to be treated separately. In 1982 it was decided to stop the dumping and store the waste on land in an intermediate waste storage facility for a period of 50 to 100 years. This period will be used to select a method for final disposal. Apart from minor changes, the methods for conditioning the waste, used before 1982, have been maintained up till now.

33807 (Juel-Conf—54, pp 601-613) **Aspects on the licensing of a final repository for reactor wastes.** Larsson, A.; Wingefors, S. (Swedish Nuclear Power Inspectorate, Stockholm, Sweden). Jun 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE86752037. (CONF-8506114—).

From International seminar on radioactive waste products suitability for final disposal; Julich, F.R. Germany (10 Jun 1985).

One of the more important issues is the performance of the repository as an integrated system considering its content of various waste forms, barriers, etc. By relying entirely on the stability of the barriers, such as concrete and bentonite, some difficulties could be mitigated in the risk evaluation. To what extent the barriers would be influenced by processes depending on the properties of the wastes is discussed. Two such processes are described, namely gas evolution from corrosion of steel and swelling of ion exchange resins incorporated in bitumen. Finally, the interplay between the control programme during the construction work and the development of waste acceptance criteria is delineated.

33808 (Juel-Conf—54, pp 614-621) **Technical considerations at Ontario Hydro for disposal of radioactive waste.** Rao, P.K.M. (Ontario Hydro, Toronto, Canada. Nuclear Materials Management Dept.). Jun 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE86752037. (CONF-8506114—).

From International seminar on radioactive waste products suitability for final disposal; Julich, F.R. Germany (10 Jun 1985).

Ontario Hydro is currently carrying out studies for the disposal of low- and intermediate-level wastes generated at the CANDU nuclear generating stations. A screening study of a number of generic concepts led to selection of underground disposal concepts at shallow to intermediate depths for further studies. These concepts could be hosted in generally impermeable soil media such as clay and till and impermeable rock media such as limestone/shale, available in Southern Ontario geology. Although the concepts are considered adequate for majority of low- and intermediate-level wastes, the adequacy with respect to a segment of the waste containing large quantities of C-14, remains to be assessed in a broader context, with site specific data on hydrogeology, geochemistry and dispersion/dilution characteristics and the leaching properties of the wasteform, all of which are currently being studied.

33809 (Juel-Conf—54, pp 622-631) **Formalism and models for the derivation of acceptance requirements on radioactive waste from radiation protection considerations for Konrad waste repository.** Lange, F.; Mueller, W. (Gesellschaft fuer Reaktorsicherheit m.b.H., GRS, Koeln, Germany, F.R.). Jun 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE86752037. (CONF-8506114—).

From International seminar on radioactive waste products suitability for final disposal; Julich, F.R. Germany (10 Jun 1985).

It is planned to use the former iron ore mine Konrad as a final repository for low-level radioactive waste. This paper deals in some more detail with two parts of the safety analysis: Firstly, how the general radiation protection requirements during normal oper-

ation like dose limits or release limits have been converted to acceptance requirements for waste packages intended for disposal in the Konrad mine. Secondly, the degree of specifications about the radionuclide inventory of waste packages which is necessary to show compliance with radiation protection requirements derived from incident analysis.

33810 **(KAERI/MR—80/84) Treatment of radioactive wastes.** Park, H.H.; Han, K.W.; Kim, K.J.; Wee, K.S.; Lee, J.D.; Cho, K.H.; Yoon, M.H. (Korea Advanced Energy Research Inst., Daeduk (Republic of Korea)). Mar 1985. 151p. (In Korean). NTIS (US Sales Only), PC A08/MF A01. File Number DE86702195.

In this study, treatment facilities of radioactive liquid and solid wastes from KAERI were sufficiently operated and repaired to improve the safety in treatment and the participated in trial run of water treatment in PIEF to treat safety the radioactive wastes from PIEF through performing the committed treatment from other institution using RIs, due to insufficiency of storage and treatment facilities, to treat efficiently and safely, to prevent from damage of radio rays.

33811 **(KAERI/RR—447/84) Study on the policy for the radioactive waste treatment and disposal.** Park, H.H.; Suh, I.S.; Kim, H.Y.; Cho, Y.H.; Juhn, P.I.; Han, K.W. (Korea Advanced Energy Research Inst., Daeduk (Republic of Korea)). Mar 1985. 185p. (In Korean). NTIS (US Sales Only), PC A09/MF A01. File Number DE86702196.

In this report, the establishment of the policy for the safe long-term isolation of radioactive wastes from human environment is studied in three scopes: radioactive waste management in the radioisotope application industries; foundation plan for the Radioactive Waste Management Agency (RMWA); consideration on the spent fuel management methodology. Through this research, the status of radioactive waste management in Korea is understood more clearly. Also the basic priciples of the policy for radioactive waste management are derived and the performance methodologies are proposed. Such an efficient and systematic radioactive waste management will increase the safety of the radioactive waste management and the public's confidence on the nuclear power.

33812 **(KAERI/RR—451-1/84) Planning for the radioactive waste treatment facility operation. Establishment of RWTF management program.** Park, H.H.; Han, K.W.; Kim, J.H. (Korea Advanced Energy Research Inst., Daeduk (Republic of Korea)). Apr 1985. 315p. (In Korean). NTIS (US Sales Only), PC A14/MF A01. File Number DE86702178.

In accordance with treatment of radioactive wastes from normal operation of PIEF and nuclear fuel fabrication facilities, institutions using RI, of spent fuel from nuclear power plants, the operation of RWTF is requested. Therefore the objective is to treat the radioactive wastes safely by the treatment techniques accumulated through research experiences of many years, to minimize the effect to environments and inhabitants, and to establish the operation program to perform the facilities management effectively and reasonably.

33813 (KAERI/RR—451-2/84, pp 15-124) **Cementation process study.** Park, H.H.; Han, K.W.; Ahn, S.J.; Choi, K.S.; Lee, M.W.; Ryu, Y.K. (Korea Advanced Energy Research Inst., Daeduk, Republic of Korea). Apr 1985. (In Korean). NTIS (US Sales Only), PC A09/MF A01. File Number DE86780465.

In Study on the radioactive liquid waste reduction and solidification.

In the cementation process study, in 1984, design of the waste treatment simulator was finished for the first step. We can experience not only the operation of solidification system but the design and construction of coming large scale plant through the design of cementation process.

33814 (KAERI/RR—451-2/84, pp 125-173) **Bituminization process study.** Park, H.H.; Han, K.W.; Ahn, S.J.; Choi, K.S.; Lee, M.W.; Ryu, Y.K. (Korea Advanced Energy Research Inst., Daeduk, Republic of Korea). Apr 1985. (In Korean). NTIS (US Sales Only), PC A09/MF A01. File Number DE86780465.

In Study on the radioactive liquid waste reduction and solidification.

With respect to bituminization process, swelling and sedimentation properties of the bitumin-resin product influence the leachability of radioisotope and viscosity the fluidibility in process. Swelling ratio of the product in water was increased in proportion to resin content and somewhat with resin size decrease but the effect of resin size was not much. Swelling ratio of the product with 10-40% resin during 100 days in water was below 2.5%. Sedimentation of resin below 200 mesh in the product was negligible and leachability of 30% resin-bitumen product (resin size below 200 mesh) was $2 \times 10^{-5} g/cm^2$ day. In case of treating, the ion-exchange resin after grinding, the proper size of resin to prevent sedimentation was below 200 mesh. Operation experience of small-scale bituminization apparatus showed that it was different to treat spent ion-exchange resin above 30% in product due to its viscosity and that infra-red thermometer (Heat spy) could be utilized to measure the temperature of products in real bituminization process.

33815 **(KAERI/RR—451-2/84) Study on the radioactive liquid waste reduction and solidification.** (Korea Advanced Energy Research Inst., Daeduk (Republic of Korea)). Apr 1985. 176p. (In Korean). NTIS (US Sales Only), PC A09/MF A01. File Number DE86780465.

Individual papers were processed for the data base.

33816 **(KAERI/RR—451-3/84) Conceptual design of an incineration system .** Park, H.H.; Han, K.W.; Cho, W.J.; Park, J.K. (Korea Advanced Energy Research Inst., Daeduk (Republic of Korea)). Apr 1985. 236p. (In Korean). NTIS (US Sales Only), PC A11/MF A01. File Number DE86702198.

The state of art of incineration technology is investigated for the combustible radioactive waste arising from the nuclear facilities. The classification of combustible radioactive waste are described, and the characteristics, the state of development of various type radioactive waste incinerators and off gas treatment systems are summarized. These incinerators and off gas treatment systems are evaluated on the view point of engineering and economy, and it is intended to choose the optimum types of incinerator and off gas treatment system according to the purpose of use. As a result, the controlled air incinerator, pyrolysis incinerator, and excess incinerator seem to be promising for the incineration of low level radioactive waste, and the high temperature, dry off gas treatment system is favorable.

33817 **(KAERI/RR—451/84) Development of radwaste treatment and disposal technology.** Park, H.H.; Han, K.W.; Ahn, S.J.; Kim, J.H.; Cho, W.J.; Choi, K.S.; Park, J.K. (Korea Advanced Energy Research Inst., Daeduk (Republic of Korea)). Apr 1985. 85p. (In Korean). NTIS (US Sales Only), PC A05/MF A01. File Number DE86702199.

The project has been performed for the development of technologies concerning radwaste treatment, disposal and shielded structures for handling radioactive materials. The radwaste treatment facility (RWTF) is expected to be in completion by the end of '85 and the facility comprises evaporation and bituminization process for liquid waste, cement-asphalt conditioning process for solid waste, and decontamination processes. Solidified cement products have been evaluated to determine optimum conditions of mixing of various components by means of testing mechnical strength and leaching rate of the products. On the other hand, underground radionuclides movement behavior was simulated introducing one dimensional diffusion model with empirically determined distribution coefficients and permeability in order to evaluate disposal safety. The simulation was done for domestic clay with Sr-90 and Cs-137. Standardization and related quality control methods established for design and construction of shielding structure (hot cell) have been tried based on the experiences of construction of nuclear facilities imported to KAERI.

33818 **(NUREG/CR—4519) Technology, safety and costs of decommissioning reference nuclear fuel cycle facilities.** Elder, H.K. (Pacific Northwest Labs., Richland, WA (USA)). May 1986. Contract AC06-76RL01830. 32p. (PNL—5586). NTIS, PC A03/MF A01 - GPO. File Number TI86011208.

The radioactive wastes expected to result from decommissioning nuclear fuel cycle facilities are reviewed and classified in accordance with 10 CFR 61. Most of the wastes from the MOX plant (exclusive of the lagoon wastes) will require interim storage (11% Class A 49 m^3; 89% interim storage, 383 m^3). The MOX plant lagoon wastes are Class A waste (2930 m^3). All of the wastes from the U-Fab and UF_6 plants are designated as Class A waste (U-Fab 1090 m^3, UF_6 1259 m^3).

33819 **(NUREG/CR—4601) Technical considerations affecting preparation of ion-exchange resins for disposal.** Bowerman, B.S.; Piciulo, P.L. (Brookhaven National Lab., Upton, NY (USA)). May 1986. Contract AC02-76CH00016. 95p. (BNL-NUREG—51987). NTIS, PC A05/MF A01 - GPO. File Number TI86010941.

Three incidents involving low-level waste (LLW) from separate nuclear power plants, i.e., dewatered ion-exchange resins or dewatered filter media, occurred during 1983 and 1984. This report summarizes and reviews the investigations into the causes of each incident. Factors unique to each incident are discussed and recommendations are given on the basis of these factors which may help limit such occurrences in the future.

33820 **(ORNL/TM—9694) GRESS translation of the ORIGEN2 code.** Pin, F.G.; Wright, R.Q. (Oak Ridge National Lab., TN (USA)). May 1986. Contract AC05-84OR21400. 39p. NTIS, PC A03. File Number DE86011355.

ORIGEN2 is a widely used point-depletion and radioactive-decay computer code for use in simulating nuclear fuel cycles and/or spent fuel characteristics. In typical applications the code calculates chain buildup and decay of more than 1600 radionuclides and elements. This report describes the addition to the ORIGEN2 code of an automated sensitivity calculation capability by means of the GRESS precompiler. The GRESS precompiler uses computer calculus to automatically enhance FORTRAN computer codes with derivative-taking capabilities. From these derivatives generated concurrently with the normal results, sensitivities of any variable used in the code with respect to any other variable or input parameter can readily be obtained. The added sensitivity calculation capability is verified on a sample problem involving fuel burnup under specified power, radioactive decay, and material irradiation under specified flux. The accuracy of the GRESS results is demonstrated using comparisons with the results of perturbation analyses.

33821 **(ORNL/TM—9742) Field evaluation of a cement-bentonite grout and a chlorosulfonated polyethylene fabric liner in hydrologically isolating low-level radioactive solid waste.** Davis, E.C.; Spalding, B.P. (Oak Ridge National Lab., TN (USA)). May 1986. Contract AC05-84OR21400. 98p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86011347.

Two engineered modifications, trench lining and grouting, have been demonstrated and evaluated. Reinforced chlorosulfonated polyethylene (Hypalon) fabric and a Portland cement-bentonite grout were selected for demonstration within a group of nine 28-m^3 experimental trenches containing compacted low-level waste generated at the Oak Ridge National Laboratory. Groundwater monitoring has shown that standing water is present in all nine experimental trenches (both treated and untreated); however, depth of water and water level fluctuation patterns differed according to trench treatment and were minimal in the case of the grouted trenches. Both water pump-in and water pump-out tests conducted on the lined trenches showed that the original goal of watertight liners was not achieved and that water was entering and leaving these trenches with each precipitation event. Water entering into the grouted trenches was inhibited by the cement-bentonite grout backfill, as reflected in the lower values of hydraulic conductivities that were measured in these three trenches compared with those in the three control (untreated) trenches. In examining engineering properties of the grout and liner material, it was found that no significant change in liner tensile strength or liner aging study, indicating that there were no short-term changes in these engineering properties with field weathering. Cover subsidence has not occurred over the grouted or control trenches, while 2 of the lined trenches have settled 7 to 10 cm (2 to 3% of the trench depth) in the first two years. Based on these treatment evaluation tests, the cement-bentonite grouted trenches appear to offer the highest level of water protection compared to the Hypalon lined and the control trenches.

33822 **(ORNL/TM—9789) Mock Site Licensing Demonstration Project. Final report.** Roop, R.D. (Oak Ridge National Lab., TN (USA)). Jun 1986. Contract AC05-84OR21400. 81p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86011392.

The Mock Site Licensing Demonstration Project developed the Low-Level Radioactive Waste Siting Simulation, a role-playing exercise designed to facilitate the process of siting and licensing disposal facilities for low-level waste (LLW). This report describes the development, contant, and usefulness of the siting simulation. The simulation was designed by Harvard University's Program on Negotiation; it can be conducted at a workshop or conference, involves 14 or more participants, and requires about eight hours to complete. The simulation consists of two sessions. In the first, participants negotiate the selection of siting criteria, and in the second, a preferred site for a facility is chosen from three candidate sites. The project sponsored two workshops (in Boston, Massachusetts and Richmond, Virginia) in which the simulation was conducted for persons involved in planning for LLW. It is concluded that the siting simulation can be useful in three ways: (1) as a tool for information dissemination, (2) as a vehicle that can foste communication among parties in conflict, and (3) as a step toward consensus building and conflict resolution. The DOE National Low-Level Waste Management Program is now making the siting simulation available for use by states, regional compacts, and other organizations involved in development of LLW disposal facilities.

33823 **(PNL—5780) Design and operating features of the high-level waste vitrification system for the West Valley demonstration project.** Siemens, D.H.; Beary, M.M.; Barnes, S.M.; Berger, D.N.; Brouns, R.A.; Chapman, C.C.; Jones, R.M.; Peters, R.D.; Peterson, M.E. (Pacific Northwest Labs., Richland, WA (USA)). Mar 1986. Contract AC06-76RL01830. 179p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE86010858.

A liquid-fed joule-heated ceramic melter system is the reference process for immobilization of the high-level liquid waste in the US and several foreign countries. This system has been under development for over ten years at Pacific Northwest Laboratory and other national laboratories operated for the US Department of Energy. Pacific Northwest Laboratory contributed to this research through its Nuclear Waste Treatment Program and used applicable data to design and test melters and related systems using remote handling of simulated radioactive wastes. This report describes the equipment designed in support of the high-level waste vitrification program at West Valley, New York. Pacific Northwest Laboratory worked closely with West Valley Nuclear Services Company to design a liquid-fed ceramic melter, a liquid waste preparation and feed tank and pump, an off-gas treatment scrubber, and an enclosed turntable for positioning the waste canisters. Details of these designs are presented including the rationale for the design features and the alternatives considered.

33824 **(PNL-SA—13364) Waste canister closure welding using the inertia friction welding process.** Klein, R.F.; Siemens, D.H.; Kuruzar, D.L. (Pacific Northwest Labs., Richland, WA (USA)). Feb 1986. Contract AC06-76RL01830. 7p. (CONF-860317—50). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011141.

From Waste management '86; Tucson, AZ, USA (2 Mar 1986).

Liquid radioactive waste presently stored in underground tanks is to undergo a vitrifying process which will immobilize it in a solid form. This solid waste will be contained in a stainless steel canister. The canister opening requires a positive seal weld, the properties and thickness of which are at least equal to those of the

canister material. This paper describes the inertia friction welding process and a proposed equipment design concept that will provide a positive, reliable, inspectable, and full thickness seal weld while providing easily maintainable equipment, even though the weld is made in a highly contaminated hot cell. All studies and tests performed have shown the concept to be highly feasible. 2 refs., 6 figs.

33825 **(PNL-SA—13415) Preliminary estimates of the impacts of alternative spent fuel acceptance rates.** Clark, L.L.; McKee, R.W.; Short, S.M. (Pacific Northwest Labs., Richland, WA (USA)). Feb 1986. Contract AC06-76RL01830. 7p. (CONF-860317—48). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010934.

From Waste management '86; Tucson, AZ, USA (2 Mar 1986).

The rate at which spent fuel is accepted by the federal waste management system is an important interface between the private nuclear power sector and the federal government, which will assume responsibility for spent fuel disposal. An analysis of alternative rates based on minimum age criteria indicates substantial incentives to limit acceptance rates so as to result in minimum 10 to 15 year fuel ages for repository acceptance [1500 to 2500 metric tons of uranium (MTU) per year]. These incentives include lower heat generation rates and systems costs.

33826 **(RFP—3965) Actinide removal from nitric acid waste streams.** Muscatello, A.C.; Navratil, J.D. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). [1986]. Contract AC04-76DP03533. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86010810.

Actinide separations research at the Rocky Flats Plant (RFP) has found ways to significantly improve plutonium secondary recovery and americium removal from nitric acid waste streams generated by plutonium purification operations. Capacity and breakthrough studies show anion exchange with Dowex 1 x 4 (50 to 100 mesh) to be superior for secondary recovery of plutonium. Extraction chromatography with TOPO (tri-n-octyl-phosphine oxide) on XAD-4 removes the final traces of plutonium, including hydrolytic polymer. Partial neutralization and solid supported liquid membrane transfer removes americium for sorption on discardable inorganic ion exchangers, potentially allowing for non-TRU waste disposal.

33827 **(RFP—3977) Plutonium and americium extraction studies with bifunctional organophosphorus extractants.** Navratil, J.D. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1985. Contract AC04-76DP03533. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010804.

Neutral bifunctional organophosphorus extractants, such as octylphenyl-N,N-diisobutylcarbamoylmethylphosphine oxide (CMPO) and dihexyl-N,N-diethylcarbamoylmethylphosphonate (CMP), are under study at the Rocky Flats Plant (RFP) to remove plutonium and americium from the 7M nitric acid waste. These compounds extract trivalent actinides from strong nitric acid, a property which distinguishes them from monofunctional organiphosphorus reagents. Furthermore, the reagents extract hydroytic plutonium (IV) polymer which is present in the acid waste stream. The compounds extract trivalent actinides with a 3:1 stoichiometry, whereas tetra- and hexavalent actinides extract with a stoichiometry of 2:1. Preliminary studies indicate that the extracted plutonium polymer complex contains one to two molecules of CMP per plutonium ion and the plutonium(IV) maintains a polymeric structure. Recent studies by Horwitz and co-workers conclude that the CMPO and CMP reagents behave as monodentate ligands. At RFP, three techniques are being tested for using CMP and CMPO to remove plutonium and americium from nitric acid waste streams. The different techniques are liquid-liquid extraction, extraction chromatography, and solid-supported liquid membranes. Recent tests of the last two techniques will be briefly described. In all the experiments, CMP was an 84% pure material from Bray Oil Co. and CMPO was 98% pure from M and T Chemicals.

33828 **(UCRL—15801) NNWSI waste from testing at Argonne National Laboratory. Semiannual report, July-December 1985.** Bates, J.K.; Gerding, T.J.; Abrajano, T.A. Jr.; Ebert, W. (Argonne National Lab., IL (USA)). Mar 1986. Contract W-31-109-ENG-38;W-7405-ENG-48. 64p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86010969.

The Nevada Nuclear Waste Storage Investigations (NNWSI) Project is investigating the volcanic tuff beds of Yucca Mountain, Nevada, as a potential location for a high-level radioactive waste repository. As part of the waste package development portion of this project, experiments are being performed by the Chemical Technology Division of Argonne National Laboratory to study the behavior of the waste forms under anticipated repository conditions. These experiments include (1) the development and performance of a test to measure waste form behavior in unsaturated conditions and (2) the performance of tests designed to study the behavior of waste package components in an irradiated environment. Previous reports document developments in these areas through 1984. This report summarizes progress in 1985. Reports will be issued semi-annually hereafter.

33829 **(RHO-RE-TR—4) Calculation of iodine releases under different operating conditions.** Nagel, K.; Woit, J. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.)). Mar 1986. Contract AC06-77RL01030. Translation of KFK-3821, October 1984. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86010661.

On the basis of experimental results using PASSAT, a prototype of a head-end filter facility, we investigated deterministically the release of iodine by dissolver off-gas. The retention factor of the iodine filter is influenced by relative humidity of the off-gas and the available bed depth of the sorption filter. The relative humidity will be determined by off-gas temperature. The experimentally known dependence of the iodine retention factor on filter bed depth and relative humidity is described using four different two-dimensional approximations: for two kinds of dissolution processes of spent fuel, batchwise operation and dosage of acid, the release of iodine have been calculated under different operational conditions, and normal facility operation and failure of the electric heates.

33830 **Adaptation of an air-displacement slurry pump for remote service.** Peterson, M.E.; Berger, D.N.; Blair, H.T.; Siemens, D.H. (Battelle-Pacific Northwest Labs., Richland, WA). *Transactions of the American Nuclear Society;* **50**: 584-585(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

The US Department of Energy has selected the joule-heated liquid-fed ceramic melter as the process for vitrifying high-level nuclear wastes currently stored in the country. This selection has created the need for a pump to meter the concentrated mixture of liquid waste and glass-forming chemicals to the melter. Battelle Pacific Northwest Laboratory has developed and successfully tested a non-remote air displacement slurry (ADS) pump which will serve as the base design for a fully-remote pump that will be tested at the West Valley Demonstration Project. The bases for the remote design were: a) maximum possible service life and b) easy installation and removal using an overhead crane. General design characteristics are described.

33831 **Remote operation of defense waste processing facility sampling stations.** Snyder, D.E.; Gunnels, D.L. (Savannah River Lab., Aiken, SC). *Transactions of the American Nuclear Society;* **50**: 590-592(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

The objective of the full-scale liquid sampling station mockup for the Defense Waste Processing Facility (DWPF) was to demonstrate successful remote operation and replacement of all valves and instruments using remotely operated master/slave manipulators before similar stations are placed in a radioactive cell. The objective was accomplished by testing a full-scale prototype in a clean

cell that is identical to the final sampling cell. The DWPF at the Savannah River Plant is being designed in conjunction with Bechtel National, Inc., and is under construction to remove all radioactive liquid waste from site storage tanks and incorporate the waste into leach-resistant glass. Sampling stations, located in the DWPF sampling cell, will remove samples from the waste tanks for analysis before the waste is combined with borosilicate glass. Components of the samples will be identified by analysis in an adjacent cell. After the mixture of radioactive waste and glass solidifies, it will be placed in stainless steel canisters for eventual transportation to an off-site federal repository.

33832 **Facility equipment performance evaluation using microcomputer simulation analysis.** Chockie, A.D.; Hostick, C.J. (Battelle-Pacific Northwest Lab., Richland, WA). *Transactions of the American Nuclear Society;* **50**: 596-597(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

The Pacific Northwest Laboratory (PNL) recently developed a facility performance assessment model as part of the US Department of Energy-sponsored monitored retrievable storage (MRS) program at PNL. The objective in the development of this model was to assist in the evaluation of the operational performance of the MRS facility design alternatives. The microcomputer-based simulation model provided a technique for the analysis of the design and performance of alternative MRS facility systems. The model was applied to the analysis of the material flow, equipment capability, and facility layout of various designs for a facility to receive and canister spent fuel from commercial nuclear power plants. Programs were also developed that evaluated alternative facility operating schedules and facility-equipment designs. The paper is a review of the facility performance assessment model and its advantages and benefits in the analysis of alternative facility designs employing varying degrees of remote handling capability.

33833 **PREPD O & VE remote handling system.** Theil, T.N. (EG & G Idaho, Inc., Idaho Falls). *Transactions of the American Nuclear Society;* **50**: 598(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

The Process Experimental Pilot Plant (PREPP) at the Idaho National Engineering Laboratory is designed for volume reduction and packaging of transuranic (TRU) waste. The PREPP opening and verification enclosure (O & VE) remote handling system, within that facility, is designed to provide examination of the contents of various TRU waste storage containers. This remote handling system will provide the means of performing a hazardous operation that is currently performed manually. The TeleRobot to be used in this system is a concept that will incorporate and develop man in the loop operation (manual mode), standardized automatic sequencing of end effector tools, increased payload and reach over currently available computer-controlled robots, and remote handling of a hazardous waste operation. The system is designed within limited space constraints and an operation that was originally planned, and is currently being manually performed at other plants. The PREPP O & VE remote handling system design incorporates advancing technology to improve the working environment in the nuclear field.

33834 **Topography, stresses, and stability at Yucca Mountain, Nevada.** Swolfs, H.S.; Savage, W.Z. (US Geological Survey, Denver Federal Center, CO). pp 1121-1132 of Research and engineering applications in rock masses. Volume 2. Ashworth, E. Accord, MA; A.A. Balkema Pub. (1985). (CONF-850671—).

From 26. U.S. symposium on rock mechanics; Rapid City, SD, USA (26 Jun 1985).

Plane-strain solutions are used to analyze the influence of topography on the state of stress at Yucca Mountain, Nye County, Nevada. The results are in good agreement with the measured stress components obtained in drill holes by the hydraulic-fracturing technique, particularly those measured directly beneath the crest of the ridge, and indicate that these stresses are gravitationally induced. A separate analysis takes advantage of the fact that a well-developed set of vertical faults and fractures, subparallel to the ridge trend, imparts a vertical transverse isotropy to the rock and that, as a consequence of gravitational loading, unequal horizontal stresses are induced in directions perpendicular and parallel to the anisotropy.

33835 **Preliminary evaluation of alterant geophysical tomography in welded tuff.** Ramirez, A.L.; Daily, W.D. (Lawrence Livermore National Lab., CA). pp 807-816 of Research and engineering applications in rock masses. Volume 2. Ashworth, E. Accord, MA; A.A. Balkema Pub. (1985). (CONF-850671—). Contract W-7405-ENG-48.

From 26. U.S. symposium on rock mechanics; Rapid City, SD, USA (26 Jun 1985).

The ability of alterant geophysical tomography to delineate flow paths in a welded tuff rock mass has been preliminarily evaluated based on the results of a field experiment. Electromagnetic measurements were made before, during and after a water-based, dye tracer flowed through the rock mass. Alterant geophysical tomographs were generated and compared with independent evidence - borescope logs, neutron logs and dyed rock samples. Anomalies present in the tomograph match the location and orientation of fractures mapped with a borescope. The location of tracer-stained fractures coincides with the location of some image anomalies; other geophysical anomalies exist where tracer-stained fractures were not observed, perhaps due to poor core recovery. Additional drilling to locate stained flow paths and other experiments are planned so that the applicability of the technique can be further evaluated.

33836 **Development of disposal methods and burial criteria for radioactive sodium waste.** Abrams, C.S.; Witbeck, L.C.; Subbaraman, G.; Steele, P.O. III. (Argonne National Lab., Idaho Falls, ID, USA; Rockwell International Corp., Canoga Park, CA, USA. Energy Technology Engineering Center). pp 165-170 of Liquid metal engineering and technology. 3 Vols. Proceedings of the 3. international conference held in Oxford on 9-13 April 1984. Vol. 2. London, England; British Nuclear Energy Society (1984). (CONF-840411—).

From 3. meeting on liquid metal in energy applications; Oxford, UK (9 Apr 1984).

Shallow land burial of sodium-bearing low-level radioactive wastes requires disposal processes that adequately remove the reactive sodium to levels that are safe during their handling and after their burial at licensed facilities. This paper describes the MEDEC (Melt-Drain-Evaporation-Calcination) process to be utilized for the treatment of the radioactive sodium wastes (RSW). Criteria for the forms and levels of sodium that may be present in the treated RES intended for burial were developed on the basis of laboratory tests. These criteria and the quality control procedures applicable to available RSW treatment processes, including MEDEC, are discussed.

33837 **Radioactive waste management: A DOE perspective.** Bennett, J.W. (Office of Geologic Repository Deployment, United States Dept. of Energy). pp 61-67 of Nuclear power in the Midwest. Chicago, IL; Energy Resources Center, University of Illinois (1984). (CONF-8410315—).

From 12. annual Illinois energy conference; Chicago, IL, USA (31 Oct 1984).

This paper reviews the status of the DOE nuclear waste management program and highlights the major upcoming activities. The Act outlines a careful and deliberate process for selecting repositories for the disposal of high-level waste and spent fuel. A major objective of the Act is the requirement that the federal government establish a functional waste management system. In order that we may begin accepting waste for disposal by 1998, there are numerous intermediate dates and key milestones laid out in the Act to help us achieve timely success. We are committed to 1998 as the most important date. The greatest emphasis within the U.S. Department of Energy is getting a repository in place and operating. This paper primarily concentrates on repositories. However, a repository alone does not constitute a full waste disposal system. There are many other major elements which are integral parts of the disposal system. In exchange for payments of substantial annual fees which amount to approximately $300 to $400 million, we have a contrac-

tual obligation to utilities and to ratepayers throughout the country to deliver a service on a predictable schedule. Yet, successful repository deployment on a fixed schedule cannot be guaranteed unless a credible process founded on technical and institutional excellence is to be maintained.

33838 **The Monticello, Utah, uranium mill tailings site: A case history.** Korte, N.E.; Kearl, P.M.; Sewell, J.M.; Fleischhauer, H.L.; Abramiuk, I.N. (Bendix Field Engineering Corporation, Grand Junction, CO). pp 387-396 of Management of uranium mill tailings, low-level waste, and hazardous waste;. Fort Collins, CO; Colorado State University (1984). (CONF-840245—).

From 6. symposium on management of uranium mill tailings, low-level waste, and hazardous waste; Ft. Collins, CO, USA (1 Feb 1984).

A multidisciplinary study was conducted to characterize the potential for contamination from the inactive millsite in Monticello, Utah. Emphasis was given to site geology, hydrology, and geochemistry for two reasons: (1) a perennial stream flows through the tailings area, and (2) a culinary aquifer is overlain by an alluvial aquifer contaminated by the tailings area. Study results indicate that surface-water contamination attributable to the piles exists for approximately 6 km downstream from the site. Contamination also exists in the alluvial aquifer underlying the millsite. Hydrologic studies indicate an active alluvial system, with recharge to the gravels by infiltration through the trailings. Fortunately, water-level and water-quality data, together with the results of a 51-hour pump test, indicate that the Dakota Formation is an effective aquitard, restricting the downward movement of contaminated water to the underlying culinary aquifer.

33839 **Long-term stabilization of uranium mill tailings: Effects of rock material on vegetation and soil moisture.** Beedlow, P.A.; Carlile, D.W. (Pacific Northwest Laboratory, Richland, WA). pp 531-540 of Management of uranium mill tailings, low-level waste, and hazardous waste. Fort Collins, CO; Colorado State University (1984). (CONF-840245—).

From 6. symposium on management of uranium mill tailings, low-level waste, and hazardous waste; Ft. Collins, CO, USA (1 Feb 1984).

A field-scale experiment was conducted to investigate the effects of pit-run rock and washed cable covers on vegetation and soil moisture. The success of various sand mixtures, transplanting and irrigation was evaluated. Total cover changed negligibly from the first growing season to the next, but the structure of the vegetation changed markedly. Moderate levels of irrigation increased the establishment of perennial grasses and shrubs. Rock placed on the surface prior to planting resulted in increased cover of weeds, shrubs and forbs and decreased grass cover relative to soil without surface rock. The most successful seed mixture was one of predominantly shrub and forb species adapted to the local environment. No significant differences in soil moisture were found between surface cover types.

33840 **Hydrologic considerations for rock riprap protection of uranium tailings impoundments.** Walters, W.H.; Skaggs, R.L. (Pacific Northwest Laboratory, Richland, WA). pp 541-548 of Management of uranium mill tailings, low-level waste, and hazardous waste. Fort Collins, CO; Colorado State University (1984). (CONF-840245—).

From 6. symposium on management of uranium mill tailings, low-level waste, and hazardous waste; Ft. Collins, CO, USA (1 Feb 1984).

Pacific Northwest Laboratory is conducting an in-depth study of the application of rock riprap for the long-term protection of uranium tailings impoundments. Decommissioned tailings sites at Grand Junction and Slickrock, Colorado were selected to review the application of riprap design methods and evaluate variable sensitivity and data requirements. Preliminary results from the Grand Junction case study indicates that the use of a safety factor in sizing the rock riprap may provide an overly conservative design that may not be justified. Some safety factor, usually a value of 1.5 to 2.0 is normally used to riprap design to allow for the uncertainties in the hydraulic calculations. The computation of the hydraulic designs variables using the probable maximum flood (PMF) event introduces conservatism into the design and the added safety factor may not be warranted. This paper presents some preliminary results from the Grand Junction site concerning the implications of using a safety factor for riprap design.

33841 **The effect of drains on the seepage of contaminants from subgrade tailings disposal areas.** Witten, A.J.; Pin, F.G.; Sharp, R.D. (Oak Ridge National Laboratory, Oak Ridge, TN). pp 167-176 of Management of uranium mill tailings, low-level waste, and hazardous waste. Fort Collins, CO; Colorado State University (1984). (CONF-840245—).

From 6. symposium on management of uranium mill tailings, low-level waste, and hazardous waste; Ft. Collins, CO, USA (1 Feb 1984).

A numerical simulation study is performed to investigate the influence of ponded water and a bottom drain on the pathways for contaminant migration from a subgrade uranium mill tailings disposal pit. A numerical model is applied to a generic disposal pit constructed with a bottom clay liner and steep unlined sidewalls. The migration of a two-contaminant system is modeled assuming that neither contaminant decays and only one contaminant is retarded. Two dominant pathways are indentified; one associated with lateral sidewall leakage and the other associated with transport through the bottom clay liner. It is found that the drain serves to reduce migration through the sidewall which, in turn, prevents the retarded contaminant from reaching the aquifer. The ponded water provides increased head which causes an accelarated vertical movement of moisture through the clay liner.

33842 **Predicting radon flux from uranium mill tailings.** Freeman, H.D.; Hartley, J.N. (Pacific Northwest Laboratory, Richland, WA). pp 221-233 of Management of uranium mill tailings, low-level waste, and hazardous waste. Fort Collins, CO; Colorado State University (1984). (CONF-840245—).

From 6. symposium on management of uranium mill tailings, low-level waste, and hazardous waste; Ft. Collins, CO, USA (1 Feb 1984).

Pacific Northwest Laboratory (PNL), under contract to the U.S. Department of Energy (DOE) Uranium Mill Tailings Remedial Action Project (UMTRAP) office, is developing technology for the design of radon barriers for uranium mill tailings piles. To properly design a radon cover for a particular tailings pile, the radon flux emanating from the bare tailings must be known. The tailings characteristics required to calculate the radon flux include radium-226 content, emanating power, bulk density, and radon diffusivity. This paper presents theoretical and practical aspects of estimating the radon flux from an uranium tailings pile. Results of field measurements to verify the calculation methodology are also discussed.

33843 **Statewide screening for low-level radioactive waste shallow land burial sites.** Staub, W.P.; Cannon, J.B.; Stratton, L.E. (Energy Division, Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, TN 37830). pp 577-584 of Management of uranium mill tailings, low-level waste, and hazardous waste. Fort Collins, CO; Colorado State University (1984). (CONF-840245—).

From 6. symposium on management of uranium mill tailings, low-level waste, and hazardous waste; Ft. Collins, CO, USA (1 Feb 1984).

A methodology was developed for statewide low-level waste site screening based on NRC site selection criteria. The methodology and criteria were tested in Tennessee to determine their effectiveness in narrowing the choice of sites for more intensive localized site screening. The statewide screening methodology entailed two steps. The first step was to select one or more physiographic provinces wherein sites meeting the criteria were most likely to be found. The second step was to select one or more suitable outcrop bands from within the most favorable physiographic provinces. These selections were based entirely on examination of existing literature and maps at scales no larger than 1:250,000. The statewide screening project identified only one suitable physiographic province (the Mississippi Embayment region) and one favorable outcrop band (the Coon Creek Formation) within a three county area of western Tennessee. Ground water monitoring and predictability proved to be the most difficult criterion to meet. This criterion

alone eliminated other outcrop bands in the Mississippi Embayment as well as the Eastern Highland Rim physiographic provinces. Other provinces failed to meet several screening criteria.

33844 **Corrective measures to stabilize subsidence in low-level waste trenches.** Roop, R.D.; Staub, W.P.; Hunsaker, D.B. Jr.; Ketelle, R.H.; Lee, D.W.; Pin, F.G.; Witten, A.J. (Union Carbide Corporation). pp 567-576 of Management of uranium mill tailings, low-level waste, and hazardous waste. Fort Collins, CO; Colorado State University (1984). (CONF-840245—). Contract W-7405-ENG-26.

From 6. symposium on management of uranium mill tailings, low-level waste, and hazardous waste; Ft. Collins, CO, USA (1 Feb 1984).

Shallow-land burial of low-level radioactive wastes is frequently followed by subsidence: the slumping, cave-in, or depression of the trench's surface. This paper describes and evaluates the measures proposed for correcting subsidence, including roller compaction, grouting, explosives, surcharging, falling mass, pile driving, in-situ incineration, and accelerated decomposition. Corrective measures for subsidence are evaluated in terms of effectiveness, applicability, and cost. The evaluation indicates that one method, falling mass, is considered to be effective, widely applicable and relatively low in further development and field testing. Many uncertainties associated with the cost and effectiveness of corrective measures can best be resolved by experimental field demonstration.

33845 **TOUGH - a numerical model for nonisothermal unsaturated flow to study waste canister heating effects.** Pruess, K.; Wang, J.S.Y. (Lawrence Berkeley Lab., CA). *Materials Research Society Symposia Proceedings;* **26**: 1031-1038(1984).

The physical processes modeled and the mathematical and numerical methods employed in a simulator for non-isothermal flow of water, vapor, and air in permeable media are briefly summarized. The simulator has been applied to study thermohydrological conditions in the near vicinity of high-level nuclear waste packages emplaced in unsaturated rocks. The studies reported here specifically address the question whether or not the waste canister environment will dry up in the thermal phase. 13 references, 8 figures, 2 tables.

33846 **High waste loaded commercial radwaste ceramics.** Morgan, P.E.D.; Shaw, T.M.; Pugar, E.A. (Rockwell International Science Center, Thousand Oaks, CA. 91360). pp 207 of Waste management '83. Volume 2. Post, R.G. Tucson, AZ; University of Arizona (1983). (CONF-830205—).

From Waste management conference; Tucson, AZ, USA (27 Feb 1983).

Results are presented for two kinds of possible forms for disposal of Barnwell and NFS commercial waste streams. Mineralogical types, Perovskite, Pyrochlore and Monazite are the main host phases for Barnwell material while Nepheline encapsulation is chosen for the NFS type. The million year Actinide hazards appear to be securely isolated in these forms as suggested by the geological record. Simplicity (ergo economy) is stressed by mixing streams, no separations, high waste loading and generic HIP processing. Future processing of commercial wastes should be attuned to the end waste form in the simplest way.

0530 Environmental Aspects

REFER ALSO TO CITATION(S) 33766, 33853, 34787, 34811, 34813, 34822, 34824, 34825, 34855, 34859

33847 **(IOS-Rep—197) Implications of sedimentological and hydrological processes on the distribution of radionuclides in a salt marsh near Sellafield.** Carr, A.P.; Blackley, M.W.L. (Institute of Oceanographic Sciences, Taunton (UK)). 1985. 88p. NTIS (US Sales Only), PC A05/MF A01. File Number DE86751827.

The report examines sedimentological and hydrological processes affecting a salt marsh in the Ravenglass estuary, which is situated S of the Sellafield nuclear fuel reprocessing plant. The results are discussed in the context of the distribution of low-level radioactive effluent at the site. Detailed elevational measurements on sections across a subsidiary creek show mainly seasonal variations attributed to expansion of clay minerals. Transducers deployed at a range of depths in the marsh sediment point to rapid changes in pore water pressure in response to the tidal cycle and suggest infiltration of both water and radionuclides from the coarse sediments below, especially during neap tides. Desiccation cracking of the marsh clays provides preferential pathways from the surface. These, and other factors, imply distribution of radionuclides by other mechanisms than simply accretion and emphasize the environmental diversity at this location. (author).

33848 **(RHO-BW-CR—144-P) CHAINT computer code. Users guide.** Kline, N.W.; England, R.L.; Baca, R.G. (BCS Richland, Inc., WA (USA); Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Dec 1985. Contract AC06-77RL01030. 169p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE86010967.

CHAINT is a two-dimensional numerical model for the analysis of contaminant transport in a fractured porous medium. The physical processes accounted for include advection, dispersion, diffusion, retardation, radionuclide chain decay coupling, and mass injection. The computational scheme employed by CHAINT is based on a Galerkin finite-element method and block-diagonal frontal solution technique. Continuum portions of the medium may be modeled with two-dimensional isoparametric elements. Discrete features are modeled with one-dimensional elements that are embedded along the sides of the continuum elements. Principal input to this model consists of files from a predecessor MAGNUM-2D simulation of buoyancy driven fluid flow. Output from CHAINT includes a printed report of contaminant concentrations along with post-processor graphics files. This report contains information relevant to general usage of the CHAINT code.

33849 **Climatic effects of nuclear war.** Covey, C. (Univ. of Miami, FL). *BioScience;* **35**: No. 9, 563-569(Oct 1985).

Global climatic consequences of a nuclear war have, until recently, been assumed to be insignificant compared with the obviously devastating direct effects from blast, heat, and short-term fallout. But a number of investigations carried out over the past few years indicate that climatic impact could actually be severe enough to threaten the global ecosystem significantly, including regions that may not have been directly involved in the war. This change in perception comes as researchers realize that the fires ignited by nuclear explosions would generate so much smoke that, even spread over a large portion of Earth's surface, densities could be high enough to block most of the sunlight normally reaching the ground. As a result, temperatures could decrease below freezing in a nuclear winter lasting weeks to months. Smoke from fires is what would make nuclear winter so severe. Of necessity, theoretical models are relied upon to estimate the climatic impact of nuclear war. The models incorporate many uncertain assumptions, particularly regarding the small-scale details of smoke production by fires.

33850 **Mapping liquid hazardous waste migration in ground water with electromagnetic terrain conductivity measurement.** Ketelle, R.H.; Pin, F.G. (Oak Ridge National Laboratory, Oak Ridge, TN). pp 177-184 of Management of uranium mill tailings, low-level waste, and hazardous waste. Fort Collins, CO; Colorado State University (1984). (CONF-840245—).

From 6. symposium on management of uranium mill tailings, low-level waste, and hazardous waste; Ft. Collins, CO, USA (1 Feb 1984).

Electromagnetic conductivity measurements were used to map apparent ground conductivity in the vicinity of liquid hazardous waste disposal site. Approximately 600 conductivity measurements were obtained to prepare a conductivity map of the site which includes an area 12 ha (30 acres). Conductivity measurements in the area correlate with specific conductance measurements of surface and ground water samples. Contouring of the conductivity data located contaminant migration pathways in the subsurface. A complex contaminant plume was defined by the conductivity survey. Conductivity values obtained reflected anisotropic characteristics related to local bedrock structure. Anisotropic characteristics of measurements and the use of different instrument configura-

tions indicated semiquantitatively the depth of the high conductivity zone and the direction of flow.

33851 **The collection and field chemical analysis of water samples.** Korte, N.E.; Ealey, D.T.; Hollenbach, M.H. (Geochemical Support Department, Laboratory Services Division, Bendix Field Engineering Corporation, Grand Junction, CO). pp 659-668 of Management of uranium mill tailings, low-level waste, and hazardous waste. Fort Collins, CO; Colorado State University (1984). (CONF-840245—).

From 6. symposium on management of uranium mill tailings, low-level waste, and hazardous waste; Ft. Collins, CO, USA (1 Feb 1984).

A successful water sampling program requires a clear understanding of appropriate measurement and sampling procedures in order to obtain reliable field data and representative samples. It is imperative that the personnel involved have a thorough knowledge of the limitations of the techniques being used. Though this seems self-evident, many sampling and field-chemical-analysis programs are still not properly conducted. Recognizing these problems, the Department of Energy contracted with Bendix Field Engineering Corporation through the Technical Measurements Center to develop and select procedures for water sampling and field chemical analysis at waste sites. The fundamental causese of poor field programs are addressed in this paper, largely through discussion of specific field-measurement techniques and their limitations. Recommendations for improvement, including quality-assurance measures, are also presented.

33852 **Mapping subsurface pathways for contaminant migration at a proposed low level waste disposal site using electromagnetic methods.** Pin, F.G.; Ketelle, R.H. (Environmental Impact Section, Oak Ridge National Laboratory, Oak Ridge, TN). pp 605-612 of Management of uranium mill tailings, low-level waste, and hazardous waste. Fort Collins, CO; Colorado State University (1984). (CONF-840245—).

From 6. symposium on management of uranium mill tailings, low-level waste, and hazardous waste; Ft. Collins, CO, USA (1 Feb 1984).

Electromagnetic methods have been used to measure apparent terrain conductivity in the downstream portion of a watershed in which a waste disposal site is proposed. At that site, the pathways for waste migration in ground water are controlled by subsurface channels. The channels are identified using isocurves of measured apparent conductivity. Two upstream channel branches are found to merge into a single downstream channel which constitutes the main drainage path out of the watershed. The identification and mapping of the ground water pathways is an important contribution to the site characterization study and the pathways analysis. The direct applications of terrain conductivity mapping to the planning of the monitoring program, the hydrogeological testing, and the modeling study are demonstrated.

0540 Health And Safety

REFER ALSO TO CITATION(S) 33761, 33763

33853 **(ANL—86-25) Site surveillance and maintenance program for Palos Park, report for 1985.** Golchert, N.W.; Sedlet, J. (Argonne National Lab., IL (USA)). Apr 1986. Contract W-31-109-ENG-38. 38p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86010870.

The results of the environmental monitoring program conducted at Site A/Plot M in the Palos Park area for CY 1985 are presented. The monitoring program is the ongoing remedial action that resulted from the radiological characterization of the site. The current program consists of sample collection and analysis of air, surface and subsurface water, and bottom sediment to determine the migration pathway of water from the burial ground (Plot M) to the wells, establish if other buried radionuclides have migrated, and otherwise characterize the radiological environment of the area. Earlier studies had determined that hydrogen-3 (as tritiated water) migrated from the burial ground and was detected in two nearby hand-pumped picnic wells. Hydrogen-3 in the Red Gate Woods picnic well continued to show the same pattern of elevated levels in the winter and low concentrations in the summer, but the magnitude of the winter peak (2.5 nCi/L) was significantly less than in earlier years. Tritiated water continues to be monitored at a number of wells, boreholes, and surface streams where it has been detected in the past. For many years it was the only radionuclide found to have migrated until recent measurements indicated the presence of strontium-90 in borehole water next to Plot M. The presence of the strontium-90 is an indicator of migration of radionuclides other than tritiated water from the Plot. However, the results of the program indicates that the radioactivity remaining at Site A/Plot M does not endanger the health or safety of the public visiting the site or those living in the vicinity.

33854 **(DOE/UMT—050425) Uranium Mill Tailings Remedial Action Project: technical approach document.** (USDOE Albuquerque Operations Office, NM. Uranium Mill Tailings Remedial Action Project Office). May 1986. 156p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE86010950.

The Uranium Mill Tailings Radiation Control Act of 1978, PL95-604, grants the Secretary of Energy authority and responsibility to perform such actions as are necessary to minimize radiation health hazards and other environmental hazards from inactive uranium mill sites. These cleanup actions are to be performed in compliance with the EPA standards (40 CFR Part 192) which became final on March 7, 1983. This document describes the general technical approaches and design criteria that are adopted by the US Department of Energy (DOE) in order to implement Remedial Action Plans (RAPs) and final designs that comply with EPA standards.

33855 **(ENEA-RT/PROT—82-13) Assessment of individual and collective doses to transport workers and population from transport of irradiated fuel.** Mancioppi, S.; Piermattei, S.; Scarpa, G. (ENEA, Rome (Italy). Direzione Sicurezza Nucleare e Protezione Sanitaria; ENEA, Casaccia (Italy). Dipartimento Protezione Ambientale e Salute dell'Uomo). Jun 1982. 23p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86901368.

The report summarizes the experimental dose measurements carried out during the loading and the shipment of spent fuel from one Italian power station (Trino Vercellese). A second goal refers to the use of the INTERTRAN code for dose estimates to operators and general public during such operations.

33856 **(GJ/TMC—27) Asessment of mobile gamma-scanning van activities in Edgemont, South Dakota.** (USDOE Task Force, Washington, DC). Apr 1986. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86010485.

All accessible thoroughfares in an area in Edgemont, South Dakota, comprising approximately 800 properties, were traversed by a mobile gamma-ray scanning van operated by Oak Ridge National Laboratory (ORNL). The purpose of the mobile survey was to identify residual radioactive contamination on properties in the vicinity of the nearby uranium tailings pile. The properties identified by mobile scanning (herein referred to as anomalies) were compared with results from walk-on measurements conducted by Battelle Pacific Northwest Laboratories (PNL). The mobile scan was successful in identifying 48% of the properties previously identified as contaminated by PNL walk-on measurements. Modification of the algorithm used by the mobile scanning van to identify radioactive contamination from the measured gamma radiation resulted in mixed success; the number of successful identifications increased but the number of false identifications increased disproportionately and unacceptably.

33857 (Juel-Conf—54, pp 533-543) **Performance of near-field barriers in the development of waste packaging criteria.** Flowers, R.H.; Keen, N.J.; Rae, J. (UKAEA Atomic Energy Research Establishment, Harwell). Jun 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE86752037. (CONF-8506114—).

From International seminar on radioactive waste products suitability for final disposal; Julich, F.R. Germany (10 Jun 1985).

In view of the complexity of models to predict the behaviour of buried radioactive waste over long periods of time, it seems prudent to address the near-field and far-field components separate-

ly to some extent. Provided the repository site eventually selected has a sufficiently low hydraulic conductivity and gradient it is possible to consider the near-field as a closed system in which equilibrium could exist between the radionuclides in solution and the solid phases. Selection and development of actual repository sites offering far-field systems which are themselves capable of ensuring safety will give a true redundancy of safety measures. The container material should be specified to provide containment of the radionuclides for up to 500 years. Cement-based waste matrices and backfill appears to offer major advantages in limiting the solubility of the majority of the long-lived radionuclides.

33858 (Juel-Conf—54, pp 544-551) **Relationship between waste acceptance specifications and disposal safety requirements in the Swiss case.** Alder, J.C.; Dorp, F. van; McCombie, C. (Nationale Genossenschaft zur Lagerung Radioaktiver Abfaelle, NAGRA, Baden, Switzerland). Jun 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE86752037. (CONF-8506114—).

From International seminar on radioactive waste products suitability for final disposal; Julich, F.R. Germany (10 Jun 1985).

Some of the most important acceptance specifications for wastes arriving at a final repository will be determined by the impact of waste package properties on the safety of disposal. Recent work in Switzerland has concentrated upon long-term safety and the results of analyses performed are being used to indicate waste package parameters to be specified. Specifications can be grouped into 3 categories; general data common to a range of packages, data to be quantified for system analyses, and parameters to be strictly controlled. Acceptance criteria can also be repository site and design-specific so that they will be developed iteratively during progressively detailed waste disposal project planning.

33859 (Juel-Conf—54, pp 591-600) **Radiation protection aspects of waste acceptance criteria.** Bergman, C.; Boge, R.; Johansson, G.; Snihs, J.O. (National Inst. of Radiation Protection, Stockholm, Sweden). Jun 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE86752037. (CONF-8506114—).

From International seminar on radioactive waste products suitability for final disposal; Julich, F.R. Germany (10 Jun 1985).

One criterion which may be used is the natural turnover rate of dangerous substances in the biosphere. With knowledge of the retarding effects in the natural barriers around the repository - the biosphere and the geosphere - on the radionuclides in the repository and knowledge of the nearfield effects it is possible to identify the most important parameters for the disposed waste packages in the environmental assessment. It may also be possible to quantify the parameters needed to make the waste disposal system acceptable and to optimize it from the radiation protection point of view.

33860 (UCRL—15688) **Human Factors Review Plan.** Paramore, B.; Peterson, L.R. (eds.). (Lawrence Livermore National Lab., CA (USA); Essex Corp., Alexandria, VA (USA)). Dec 1985. Contract W-7405-ENG-48. 261p. NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE86010561.

"Human Factors" is concerned with the incorporation of human user considerations into a system in order to maximize human reliability and reduce errors. This Review Plan is intended to assist in the assessment of human factors conditions in existing DOE facilities. In addition to specifying assessment methodologies, the plan describes techniques for improving conditions which are found to not adequately support reliable human performance. The following topics are addressed: (1) selection of areas for review describes techniques for needs assessment to assist in selecting and prioritizing areas for review; (2) human factors engineering review is concerned with optimizing the interfaces between people and equipment and people and their work environment; (3) procedures review evaluates completeness and accuracy of procedures, as well as their usability and management; (4) organizational interface review is concerned with communication and coordination between all levels of an organization; and (5) training review evaluates training program criteria such as those involving: trainee selection, qualification of training staff, content and conduct of training, requalification training, and program management.

33861 **Photon shielding calculations for a radiation waste facility benchmark.** Estes, G.P.; Urban, W.T.; Heath, A.R. (Los Alamos National Lab., NM). *Transactions of the American Nuclear Society;* 50: 477-479(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

Photon transport calculations have been performed for the ANS 6.2.1 radiation waste facility shielding benchmark using the continuous energy Monte Carlo code MCNP, and ONEDANT and TWODANT discrete ordinates codes. Comparisons are made of integral dose rates and flux spectra calculated with the three codes for various geometries, cross-section sets, and source and output energy group structures.

33862 **An update report on the uranium mill.** Matthews, M.L. (Uranium Mill Tailings Remedial Actions Project Office, U.S. Department of Energy, Albuquerque, NM). pp 413-422 of Management of uranium mill tailings, low-level waste, and hazardous waste. Fort Collins, CO; Colorado State University (1985). (CONF-840245—).

From 6. symposium on management of uranium mill tailings, low-level waste, and hazardous waste; Ft. Collins, CO, USA (1 Feb 1984).

In 1978, Congress enacted Public Law 95-604, the "Uranium Mill Tailings Radiation Control Act of 1978". The Act authorized the Department of Energy (DOE) to perform remedial actions at designated inactive uranium mill tailings sites. DOE established the Uranium Mill Tailings Remedial Actions Project Office to implement, in cooperation with the affected States, Indian tribes and owners of the sites, remedial actions at the sites. The UMTRA Project Office has completed an intensive research and development program and begun remedial actions at one mill site and numerous vicinity properties in accordance with EPA cleanup standards. Remedial actions at additional locations are planned.

33863 **The suitability of vegetation for erosion control on uranium mill tailings: A regional analysis.** Beedlow, P.A.; McShane, M.C. (Pacific Northwest Laboratory, Richland, WA). pp 521-530 of Management of uranium mill tailings, low-level waste, and hazardous waste. Fort Collins, CO; Colorado State University (1984). (CONF-840245—).

From 6. symposium on management of uranium mill tailings, low-level waste, and hazardous waste; Ft. Collins, CO, USA (1 Feb 1984).

Inactive uranium mill tailings (UMTRAP sites) in the West were grouped into three major climatic regions to evaluate the suitability of vegetation for long-term stabilization: the Colorado Plateau, the West Slope of the Rocky Mountains, and the Northern Great Plains. Four general vegetation types were found at western sites: grassland, shrub, salt shrub and woodland. Soil-loss rates, calculated using the Universal Soil Loss Equation, were variable within regions and vegetation types, but trends were apparent. Calculations indicated that vegetation or vegetation plus a layer of surface rock provided adequate stabilization against long-term average soil loss on slopes of less than 10%. However, at each site, detailed analyses of erosion caused by severe storm events, gully formation and channel cutting is necessary for designing protective covers.

33864 **Radon barrier field-test monitoring at Grand Junction tailings pile.** Freeman, H.D.; Hartley, J.N.; Gee, G.W. (Pacific Northwest Laboratory, Richland, WA). pp 277-285 of Management of uranium mill tailings, low-level waste, and hazardous waste. Fort Collins, CO; Colorado State University (1984). (CONF-840245—).

From 6. symposium on management of uranium mill tailings, low-level waste, and hazardous waste; Ft. Collins, CO, USA (1 Feb 1984).

Pacific Northwest Laboratory (PNL), as part of the Department of Energy (DOE) Uranium Mill Tailings Remedial Action Project (UMTRAP) technology development program, has conducted three large-scale fields tests of radon covers at the uranium mill tailings pile in Grand Junction, Colorado. The barrier systems, monitored for radon flux for over two years, include earthen, multilayer, and asphalt emulsion covers. Results of the monitoring have shown that a variety of cover systems can meet the Environmental

Protection Agency (EPA) standard. The most effective covers tested were asphalt emulsion and earthen (mancos shale).

33865 **Hydraulic setting and ground-water chemistry characterization of the Vitro uranium mill tailings site South Salt Lake, Utah.** Brinkman, J.E.; Ericson, P.E.; Price, J.B.; Lewis, D.R. (Sergent, Hauskins and Lincoln Road, N.E., Albuquerque, NM 87109). pp 473-482 of Management of uranium mill tailings, low-level waste, and hazardous waste. Fort Collins, CO; Colorado State University (1984). (CONF-840245—).

From 6. symposium on management of uranium mill tailings, low-level waste, and hazardous waste; Ft. Collins, CO, USA (1 Feb 1984).

The abandoned uranium mill tailings pile located in the vicinity of Salt Lake City, Utah, has contributed contaminants associated with uranium processing to the near-surface unconfined aquifer system beneath the pile. The site is being studied as part of the U.S. Department of Energy's (DOE's) Uranium Mill Tailings Remedial Action (UMTRA) Project. The pile is located in the Jordan River Valley of Utah. The ground-water regime in the area consists of two distinct but interconnected aquifers: a shallow, brackish, unconfined aquifer with water levels within 3 feet of the ground surface, and a deeper, confined aquifer with head levels above the ground surface and measurable artesian flow. The current hydrodynamics prevent the brackish waters of the unconfined system from reaching the deeper system from reaching the deeper system unless stressed by large production wells. Detailed field investigations, laboratory studies, and hydrodynamic computer modeling have been used to evaluate the existing conditions.

33866 **Computer code for criticality detector placement and evacuation analysis.** Hall, C.J.; Marsh, D.A. (Rockwell Hanford Operations, Richland, WA). pp 4103-4107 of Computer applications in health physics. Kathren, R.L.; Higby, D.P.; McKinney, M.A. Richland, WA; Health Physics Society (1984). (CONF-840202—).

From 17. midyear topical meeting of the Health Physics Society; Pasco, WA, USA (5 Feb 1984).

One of the risks inherent in operation of a Pu handling and processing facility is the possibility of a criticality incident. To detect and warn personnel of a critical event, a detection and alarm system is required. A computer code, IRON19K has been developed to determine the best location for criticality incident detectors. The code uses a defined source, usually the minimum number of fissions in a potential critical incident or any desired level of fissions. The code uses a three dimensional wall and object library and a library of criticality detector locations. The code allows the user to define the grid size used for the facility of interest and determines the quality of detector coverage at each grid point. The code places a point source at each grid location, computes the gamma dose rate at each detector location and prints a picture with printhead symbols which show dose rates at each grid point. The code can also be used to generate anticipated dose rates at specific locations in a facility at various times after the onset of a critical event to aid in evacuation planning.

33867 **Specific uses of a data management system for data reduction and tabulation.** Little, C.A.; Blair, M.S.; Barclay, T.R. (Health and Safety Research Div., Oak Ridge National Lab., Oak Ridge, TN 37830). pp 7189 of Computer applications in health physics. Kathren, R.L.; Higby, D.P.; McKinney, M.A. Richland, WA; Health Physics Society (1984). (CONF-840202—). Contract W-7405-ENG-26.

From 17. midyear topical meeting of the Health Physics Society; Pasco, WA, USA (5 Feb 1984).

The Remedial Action Survey and Certification Activities (RASCA) group processes large amounts of data for each of the many properties surveyed each year. In previous years, data manipulation (e.g., converting from cpm to R/hr) was performed using hand calculators. A system has recently been developed which largely automates the conversion of all field data and their tabulation for reporting purposes. The system consists of three items of hardware and two items of software. The hardware includes a Commodore Business Machines (CBM) Model 8032, an 8050 dual 5 1/2 inch floppy disk drive and a Gemini dot-matrix printer. The software includes a commercial data management system, Manager (developed by Canadian Micro Distributors) and an in-house program (DATA TABLES) written to read the Manager files and print the tables. Manager is a very flexible data management system that allows entry of data into sequential files which are sortable over any selected variable. Data are entered into sequential file and stored on a floppy disk for use at a later time. When all data have been correctly edited and proofed, the DATA TABLES program is invoked to read the sequential files and print out report-ready tables. Efficiency, and especially, accuracy in preparing data for reporting have been greatly increased.

33868 **A code for debugging input in a Monte Carlo code used in neutron shielding design.** Chiao, T.; Hall, C.J. pp 7055-7060 of Computer applications in health physics. Kathren, R.L.; Higby, D.P.; McKinney, M.A. Richland, WA; Health Physics Society (1984). (CONF-840202—).

From 17. midyear topical meeting of the Health Physics Society; Pasco, WA, USA (5 Feb 1984).

A computer code, BMC-CHECK, has been developed on the HP-9845C desk top graphics computer to debug input data assembled for a three dimensional neutron and gamma dose rate calculation code, namely BMC-MG. BMC-MG code has been developed at Hanford to calculate neutron and gamma dose rates in plutonium fabrication facilities. The code uses the Monte Carlo method to solve three dimensional dose rate calculation problems. The input procedure for modeling the shielding geometry and detector locations and defining the source and the shielding material is time consuming and tedious and often errors occur, especially at the geometry modeling stage. The "debug" process for correcting errors is usually difficult and time consuming. In some cases, dose rates have been calculated without realizing the existence of errors in the model. To resolve these problems, BMC-CHECK was developed to facilitate verification of input parameters which describe shielding geometries shielding materials and source detector locations. BMC-CHECK has shortened debugging times, reduced the number of erroneous runs and reduced costs. In addition, the program provides printed error statements and a pictoral representation of the geometric model of the facility which can be used in the analysis report.

0550 Regulations

REFER ALSO TO CITATION(S) 33785, 33786, 33787, 33862, 34152, 34905, 35184

33869 **(KFK—4017) Investigations on detection sensitivity of the NRTA method for different size representing facilities. Pt. 1 and 2. Pt. 1: Input data and analysis of results. Pt. 2: Results of computer simulation.** Gupta, D.; Bicking, U.; Koutsouvelis, G. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Entwicklungsabteilung Kernmaterialsicherung). Dec 1985. 297p. NTIS (US Sales Only), PC A13/MF A01. File Number DE86752036.

The capability and limitations of the NRTA method (Near-Real-Time Accountancy method) in reprocessing facilities with different throughputs and inventories and measurement uncertainties, were investigated with a detailed computer simulated data base. These investigations have confirmed the earlier findings that the NRTA method could permit under certain operating conditions and for a number of realistic diversion scenarios, a perceptible improvement in the detection capability. Depending on the conditions prevailing, such improvements could be by a factor of 10-20, both for the detectable amounts and the detection time, over the conventional material balance method with annual inventories. The reasons for and the conditions which would permit such improvements have been discussed in detail with numerical examples in the report. (orig.).

33870 **PREPAR - A user-friendly preprocessor to create AIRDOS-EPA input data sets.** Sjoreen, A.L.; Miller, C.W.; Nelson, C.B. (Oak Ridge National Lab., Oak Ridge, TN). pp 7151-7157 of Computer applications in health physics. Kathren, R.L.; Higby, D.P.; McKinney, M.A. Richland, WA; Health Physics Society (1984). (CONF-840202—).

From 17. midyear topical meeting of the Health Physics Society; Pasco, WA, USA (5 Feb 1984).

PREPAR is a FORTRAN program designed to simplify the preparation of input for the AIRDOS-EPA computer code. PREPAR was designed to provide a method for data entry that is both logical and flexible. It also provides default values for all variables, so the user needs only to enter those data for which the defaults should be changed. Data are entered either unformatted or via a user-selected format. A separate file of the nuclide-specific data needed by AIRDOS-EPA is read by PREPAR. Two utility programs, EXTRAC and RADLST, were written to create and list this file. PREPAR writes the file needed to run AIRDOS-EPA and writes a listing of that file.

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

0701 Physical Isotope Separation

REFER ALSO TO CITATION(S) 34479, 34480, 34481, 34775

33871 Photolytic separation of isotopes in cryogenic solution. Freund, S.M.; Beattie, W.H.; Holland, R.F.; Maier, W.B. (to Dept. of Energy, Washington, DC). US Patent 4,554,060. 19 Nov 1985. Filed date 23 Aug 1979. vp.

PAT-APPL-69151.

Separation of carbon isotopes by photolysis of CS_2 in cryogenic solutions of nitrogen, krypton and argon with 206 nm light from an iodine resonance lamp is reported. The spectral distribution of the ultraviolet absorption depends on solvent. Thus, in liquid nitrogen the photolytic decomposition rate of $^{13}CS_2$ is greater than that of $^{12}CS_2$ (because the absorption of 206 nm radiation is greater for $^{13}CS_2$), whereas in liquid krypton and liquid argon the reverse is true. The shift in ultraviolet spectrum is a general phenomenon readily characterized as a function of solvent polarizability, and exhibits behavior similar to that for vibrational transitions occuring in the infrared.

0702 Radiation Sources

REFER ALSO TO CITATION(S) 34879

33872 (INIS-BR—461, pp 72) **Preparation of ^{169}Tm radiation source to measure the perturbed angular correlation.** Suita, J.C.; Souza, A.S.F. de. 1984. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. File Number DE86702106.

In Annual technical report of Nuclear Engineering Institute - Physics Department - 1984.

33873 (ITCMPPW—9/82) Ionization distribution near a plane radioisotope source (radioisotope neutralizer). Kucinski, W.; Kuczynski, R. (Politechnika Wroclawska (Poland). Inst. Techniki Cieplnej i Mechaniki Plynow). 1982. 12p. (In Polish). NTIS (US Sales Only), PC A02/MF A01. File Number DE86702177.

Analytical methods for calculation of ionization distribution for the plane α-sources are presented. Numerical calculations are presented for ^{239}Pu.

08 HYDROGEN

0801 Production

33874 (BNL—51970) Chemical/hydrogen energy systems. Annual report, January 1-December 31, 1985. (Brookhaven National Lab., Upton, NY (USA)). May 1986. Contract AC02-76CH00016. 122p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE86011367.

Research and exploratory efforts under this program have been directed towards developing a base technology that will apply to hydrogen production, storage, and transport. Areas of interest include: High Temperature Water Vapor Electrolysis for Hydrogen Generation (Westinghouse); Evaluation of Proton-Conducting Materials for Water Vapor Electrolysis (BNL/Politecnico di Milano); and Cryoadsorption of Hydrogen on Activated Carbon (Syracuse). Contributions in 1985 made by private sector contractors, university researchers, and BNL in-house technical staff are summarized in the report. Also included is a summary of related International Energy Agency (IEA) cooperative efforts as well as plans and major activities scheduled for 1986.

33875 (LA-UR—85-3023) Thermochemical hydrogen production with the sulfur dioxide-iodine cycle by utilization of dipraseodymium dioxymonosulfate as a recycle reagent. Onstott, E.I.; de Bruin, D. (Los Alamos National Lab., NM (USA)). 1986. Contract W-7405-ENG-36. 12p. (CONF-860704—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85017534.

From 6. CERI world hydrogen energy conference; Vienna, Austria (20 Jul 1986).

Insoluble, dipraseodymium oxide-sulfite-sulfate-hydrates were prepared by reaction of dipraseodymium dioxymonosulfate with sulfur dioxide in aqueous media at 340°K. These compositions reacted with iodine to yield sulfate in the solid phase and hydrogen iodide in the gas phase. High yields of hydrogen iodide were measured at 770°K for a reaction time of ten minutes. Yields also depended on the sulfite content of the hydrate compositions, and were highest when the dipraseodymium dioxymonosulfate was 60% neutralized with sulfurous acid. An increased yield of hydrogen iodide was obtained by a second iodine oxidation after separation of the first gaseous products. A water splitting thermochemical cycle utilizing these reactions is described in which hydrogen is produced by catalytic decomposition of hydrogen iodide, and oxygen results from thermal decomposition of the solid product that also yields sulfur dioxide and dipraseodymium dioxymonosulfate for recycle.

0802 Storage

REFER ALSO TO CITATION(S) 33874

09 OTHER SYNTHETIC AND NATURAL FUELS

0901 Hydrocarbon Fuels

REFER ALSO TO CITATION(S) 33883

33876 (DOE/ER/13290—2) Surface science investigation of potential intermediates, catalysts, and promoters in the synthesis of higher alcohols by metals. Progress report, Year 2. (Delaware Univ., Newark (USA)). [1986]. Contract FG02-84ER13290. 2p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86010942.

The goal of this research is to provide the fundamental knowledge required to extend recent advances in methanol synthesis catalysis to the development of selective noble metal catalysts for the synthesis of higher alcohols. The guiding hypothesis of this research is that surface alhoxide species are pivotal intermediates in the synthesis of higher alcohols, and we have therefore focussed our efforts on the formation, identification, and reaction of these intermediates.

33877 (DOE/NBM—6010850) Comparison of attached films in several anaerobic reactor configurations. Final report. Switzenbaum, M.S. (Massachusetts Univ., Amherst (USA). Dept. of Civil Engineering). Jan 1986. Contract W-31-109-ENG-38. 117p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE86010850.

Progress has been made in the basic fundamental microbiology and biochemistry associated with the anaerobic methane fermentation process. Advances have been made in the reactor configuration technology used to carry out these reactions. A situation has been reached where the advantages of anaerobic treatment can be realized and the disadvantages historically associated with anaero-

bic treatment minimized. Three of the newer reactor configurations are the anaerobic filter, anaerobic fluidized bed (AFB), and the upflow anaerobic sludge blanket (UASB). Goal of this project has been to compare the biofilms of these three reactors on a basic physical, chemical and microbiological basis. Three pilot scale anaerobic reactors were operated over a period of 16 months.

33878 **Deactivation and regeneration of a promoted transition-metal-zeolite catalyst.** Pennline, H.W.; Pollack, S.S. (Pittsburgh Energy Technology Center, U.S. Department of Energy, Pittsburgh, PA 15236). *Industrial and Engineering Chemistry, Product Research and Development;* **25**: No. 1, vp(Mar 1986).

The regeneration of a promoted transition-metal-zeolite catalyst that had been used to convert synthesis gas to gasoline-range hydrocarbons was investigated in a mixed reactor system. Carbonaceous deposits were found on the catalyst-a coprecipitated cobalt-thoria admixed with ZSM-5 zeolite-after it has been subjected to low hydrogen to carbon monoxide ratio synthesis gas at the processing conditions. Oxidative regenerations did not succeed in returning the catalyst to its initial synthesis activity. X-ray diffraction analysis of the used and regenerated catalyst samples suggested that sintering of the cobalt occurred. The crystallite size of the Co_3O_4 formed after regeneration was inversely related to the synthesis gas conversion after reduction of the Co_3O_4 to the metal.

33879 **Cogeneration using methane from sewage treatment waste digester gas.** Johnsen, H.L.; Greenway, A.R. (Elson T. Killam Associates, Inc., Millburn, NJ). *Proceedings, Annual Meeting, Air Pollution Control Association;* **1**: vp(1985). (CONF-850612—).

From Air Pollution Control Association annual meeting and exhibition; Detroit, MI, USA (16 Jun 1985).

This paper describes the efforts undertaken at the Joint Meeting of Essex & Union Counties sewage treatment plant in Elizabeth, New Jersey, to generate electricity using the gas generated by anaerobic sludge digestion. The approach taken for the Joint Meeting Plant was to design a digester-gas-fired cogeneration system using internal combustion engines with waste heat recovery systems. This paper also describes the anaerobic sludge digestion process, waste gas characteristics, previous practices for disposal and use of waste gas, a discussion of why the selected cogeneration technology was chosen, and a discussion of the environmental effects and permitting requirements of the project. Finally, initial operating results of the cogeneration system are discussed.

33880 **Direct thermochemical conversion of sewage sludge to fuel oil.** Molton, P.M.; Fassbender, A.G.; Brown, M.D. (Battelle Pacific Northwest Lab., Richland, WA). *Proceedings, Annual Meeting, Air Pollution Control Association;* **6**: vp(1985). (CONF-850612—). Contract AC06-76RL01831.

From Air Pollution Control Association annual meeting and exhibition; Detroit, MI, USA (16 Jun 1985).

The liquefaction process to be described here is not new, per se, but its application to the energy-efficient conversion of sewage sludge is at least novel. Variants on this process are in pilot plant or pre-pilot plant stage in several places in the world for the conversion of municipal garbage, wood wastes, peat, and other materials of organic nature. The authors are unaware of any real thought about potential environmental problems relating to the conversion, except for some preliminary work on the potential carcinogenicity of wood-derived oils, which is not strictly a pollution problem. The paper is directed towards a discussion of the liquefaction process for sewage sludge conversion and the potential for pollution if the process becomes practiced on a large scale.

33881 **Bacterial adaptation to an industrial wastewater.** Kremer, F.V.; Fradkin, L. (Argonne National Lab., IL). pp 275-293 of Energy from biomass and wastes V. Chicago, IL; IGT Document Center (1981).

From 5. symposium on energy from biomass and wastes; Lake Buena Vista, FL, USA (26-30 Jan 1981).

Tests have shown that the survival of microorganisms in an anaerobic digester with an industrial feed is dependent on the capability of the bacteria to adapt to a slow increase in the metals content of a sufficiently diluted wastewater. The study examined the process stability of three digesters fed varying proportions of a heavy-metal industrial waste. The metals monitored were Cr, Cd, Pb, Cu, Ni, and Zn.

33882 **Steam gasification of wood in a multi-solid fluidized-bed (MSFB) gasifier.** Feldmann, H.F.; Choi, P.S.; Paisley, M.A.; Chauhan, S.P.; Robb, C.J.; Folsom, D.W.; Kim, B.C. (Battelle Columbus Labs., OH). pp 529-548 of Energy from biomass and wastes. V. Chicago, IL; IGT Document Center (1981).

From 5. symposium on energy from biomass and wastes; Lake Buena Vista, FL, USA (26-30 Jan 1981).

Process-development-unit (PDU) tests have verified the feasibility of gasifying wood chips with steam in a compact fluidized-bed gasifier heated by a circulating entrained sand phase. The remaining char is entrained out of the dense phase with the sand and into a separate fluidized bed for combustion. The PDU consists of a 6-in. gasifier fed with wood chips ranging from 1/4 to 1 1/2 in. Thus far, carbon conversions have reached 70% at specific feed rates of over 1000 lb (dry)/hr-ft^2. The product gas has a heating value of 475-500 Btu/SCF and contains negligible tars.

0902 Alcohol Fuels

REFER ALSO TO CITATION(S) 34248

33883 **(NP—6901348) Retrospective search on biotechnologies with particular reference to fermentation processes.** (Institute for Industrial Research and Standards, Dublin (Ireland). Information Technology Group). Dec 1985. 220p. NTIS (US Sales Only), PC A10/MF A01. File Number DE86901348.

The database includes a very large number of references on methane fermentation and biogas production. In general, these were included only where there was a definite relevance to biotechnology in the form of a particular product or processes.

33884 **(TVA/OACD—85/8-1-85) Integrated fuel alcohol production systems. Phase III. Experimental facility testing report, January 15, 1984-January 15, 1985.** Barrier, J.W.; Farina, G.E.; Lightsey, G.R.; Moore, M.R.; Broder, J.D.; Forsythe, M.L. (Tennessee Valley Authority, Muscle Shoals, AL (USA). Office of Agricultural and Chemical Development). Jan 1985. Contract AI01-80CS80010. 67p. NTIS, PC A04. File Number DE86009656.

The Tennessee Valley and the US Department of Energy are conducting a cooperative research and development program for producing fuel-grade ethanol from agricultural materials. An experimental facility was built to permit plant-scale development and evaluation of the acid hydrolysis process technology. Corn stover was used first for evaluating the facility. This report provides a detailed description of the low-temperature sulfuric acid hydrolysis process, experimental plant, and tests conducted in the experimental plant to evaluate and develop process systems. A discussion of laboratory tests at TVA and Mississippi State University in support of the program is also included. Program activities include further development and evaluation of acid hydrolysis process conditions, and development of an integrated fuel-grade ethanol system including fermentation, distillation, waste utilization, waste disposal, and alternate feedstock evaluation. 19 refs., 4 figs., 8 tabs.

13 HYDRO ENERGY

1301 Resources And Availability

33885 **(AD-A—164397/2/XAB) Entrainment descriptions for mathematical modeling of pumped-storage inflows in reservoirs. Final report.** Roberts, P.J.W.; Dortch, M.S. (Georgia Inst. of Tech., Atlanta (USA). School of Civil Engineering). Oct 1985. 122p. NTIS, PC A06/MF A01.

During hydropower generation and pumpback operations of pumped-storage projects, inflows are introduced into the reservoir system. These jetlike inflows often cause considerable entrainment

of ambient water. The entrainment process can have a strong influence on the vericnl distribution of reservoir water quality when pumped-storage inflow jets are discharged into a stratified reservoir. The objective of this study was to develop algorithms to describe the pumped-storage inflow entrainment process for use in reservoir water-quality models. Pumped-storage inflow jets fall into two classes: strongly or weakly buoyant. The former class has been fairly extensively studied, and well-established mathematical models exist to predict their behavior. For this case, incorporation into a reservoir thermal model simply required adaptation of existing code. For the latter case, however, that of weakly buoyant jets,, it was found that little information existed of either a theoretical or experimental nature. For that reason, an extensive series of experiments of a fundamental nature were performed on weakly buoyant jets into arbitrary stratification. The results were then reduced to a form suitable for inclusion into reservoir water-quality simulation models. The developed algorithms were incorporated into an existing reservoir thermal-simulation code, and a test application was made for Carters Lake, a Corps of Engineers pumped-storage project in Georgia.

1304 Regulations And Licensing

33886 **(DOE/ID/10133—2) Small scale hydropower program legal and institutional aspects. Project monitor report, April 1986.** (ELI Corp., Concord, NH (USA)). Apr 1986. Contract AC07-76ID01570. 67p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86010910.

This is the third in a series of reports addressing the regulatory and institutional factors affecting the small scale hydropower industry. The period of time covered by this report is from January 1, 1986 through March 31, 1986. The information contained in this report is intended to supplement the first and second Project Monitor Reports. In the tax and finance areas, the Senate Finance Committee has started work on an alternative tax proposal developed by the committee staff.

1306 Environmental Aspects

33887 **(DOE/BP—299) New concepts in fish ladder design. Part 1. Summary. Final project report.** Orsborn, J.F. (Washington State Univ., Pullman (USA). Albrook Hydraulics Lab.). Aug 1985. Contract AI79-82BP36523. 80p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86009653.

The report looks at the most active periods of fishway research since 1938 as background for a project to apply fundamental fluid and bio-mechanics to fishway design, and develop more cost effective fish passage facilities with primary application to small scale hydropower facilities. Also discussed are new concepts in fishway design, an assessment of fishway development and design, and an analysis of barriers to upstream migration. (ACR)

33888 **(DOE/BP—588) Natural propagation and habitat improvement. Volume I. Oregon. Final and annual reports, 1984.** (USDOE Bonneville Power Administration, Portland, OR. Div. of Fish and Wildlife). Jan 1986. 666p. NTIS, PC A99/MF A01; 1; GPO Dep. File Number DE86011389.

This volume contains reports on habitat improvement and fisheries enhancement projects conducted in the following subbasins: (1) Clackamas River; (2) Hood River; :(3) Deschutes River; (4) John Day River; (5) Umatilla River; and (6) Grande Ronde River. (ACR)

33889 **(DOE/BP/12910—2) White River Falls fish passage project, Tygh Valley, Oregon. Volume II. Appendix A, fisheries habitat inventory, Mt. Hood National Forest. Final report.** (Forest Service, Mount Hood-Parkdale, OR (USA). Mount Hood National Forest). Jun 1985. Contract AI79-84BP12910. 681p. NTIS, PC A99/MF A01; 1; GPO Dep. File Number DE86011397.

Stream habitat inventories on 155 stream miles in the White River drainage on the Mt. Hood National Forest are summarized in this report. Inventory, data evaluation, and reporting work were accomplished within the framework of the budgetary agreements established between the USDA Forest Service, Mt. Hood National Forest, and the Bonneville Power Administration, in the first 2 years of a multiyear program. One hundred forty-two stream miles of those inventoried on the Forest appear suitable for anadromous production. The surveyed area appears to contain most or all of the high quality fish habitat which would be potentially available for anadromous production if access is provided above the White River Falls below the Forest boundary. About 34 stream miles would be immediately accessible without further work on the Forest with passage at the Falls. Seventy-two additional miles could be made available with only minor (requiring low investment of money and planning) passage work further up the basin. Thirty-six miles of potential upstream habitat would likely require major investment to provide access.

14 SOLAR ENERGY

33890 **(CONF-840622—) ASES 1984: proceedings of the 1984 annual meeting, American Solar Energy Society, Inc. Technical papers including invited paper from the 1983 annual meeting.** Glenn, B.H. (ed.). (American Solar Energy Society, Boulder, CO). 1984. Contract FG02-84CE30831. 890p. NTIS, PC A99/MF A01; 1; GPO Dep. File Number DE86010135.

From Annual meeting of the American Solar Energy Society; Anaheim, CA, USA (5 Jun 1984).

The proceedings of the 1984 annual meeting of the American Solar Energy Society are presented. Each paper has been separately indexed for inclusion in the Energy Data Base. (BCS)

1405 Solar Energy Conversion

REFER ALSO TO CITATION(S) 33879, 33881, 33882, 34173, 34416, 34447, 34464, 34465, 34847, 34890

33891 **(AD-A—163647/1/XAB) Biomass economy. Final report, June 1984-November 1985.** Crow, S.J. (Ultrasystems, Inc., Irvine, CA (USA)). Nov 1985. 136p. NTIS, PC A07/MF A01.

The objective of this effort was to perform an updated life-cycle-cost assessment of biomass energy conversion systems capable of meeting facility and process energy needs of Eglin AFB FL. System capabilities examined in this study were 25 and 15 MWe. Results of this study are that, although the biomass fuel is available at a reasonable cost, construction and other operating costs are too high to justify implementation of this technology based on the current cost of electricity at Eglin AFB FL.

33892 **(DOE/JPL/956312—13) Stress and efficiency studies in EFG. Quarterly progress report, July 1-September 30, 1985.** (Mobil Solar Energy Corp., Waltham, MA (USA)). 15 Jan 1986. Contract NAS-7-100-956312. 43p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86010682.

Stress analysis with increased creep rates, beyond the "high creep" condition modeled previously, shows that significant changes in residual stress arise from the imposed transverse isotherm variations. These changes are shown to be essentially independent of the detailed shape of the transverse isotherm profile. Modeling of the influence of end effects on residual stress distributions in finite size blanks has been carried out. The calculations predict the "shear flow" stress distribution used in calculation of residual stresses from laser interferometric measurements of blank curvatures under four-point bending. EBIC characterization of diffusion length of FZ silicon heat treated and stressed at 1000°C shows that larger variations in diffusion length with dislocation density are observed against background diffusion lengths of the order of 100 microns than found in samples correspondingly treated above 1200°C. A relationship between diffusion length and dislocation density has been obtained for these samples. These studies are being extended to samples stressed in the temperature region between 600°C and 900°C. An apparatus to measure stress relaxation has been designed and construction is underway. The results of characterization of different defect types in boron and in gallium doped EFG material of varying resistivities are presented.

33893 **(DOE/NBM/CE—1075) Photovoltaics: electricity from sunlight.** (USDOE, Washington, DC). Sep 1984. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86010456.

The role of photovoltaic power in the world's energy mix is discussed. The role of the US federal government in the research and development of photovoltaic technology is described as one of undertaking long-range, high-risk research and development in areas that industry is not likely to pursue because of the costs and risks involved. The commercial growth of photovoltaic technology is alluded to briefly, and the basic operating theory of photovoltaic conversion is introduced. Numerous applications of photovoltaic technology are described, including uses in communications, rural electrification, waer pumping, corrosion protectio, navigational aids, and railroads, as well as utility network power. The economics of photovoltaic power are discussed, and the products and technology of the US photovoltaic industry are described. (LEW)

33894 **(PB—86-152360/XAB) Potential for harvesting puckerbrush for fuel. Forest Service research paper (Final).** Mattson, J.A.; Winsauer, S.A. (Forest Service, St. Paul, MN (USA). North Central Forest Experiment Station). 1985. 10p. (FSRP-NC—262). NTIS, PC A02/MF A01.

The report documents the biomass in 12 typical stands of puckerbrush and evaluates the feasibility of several potential systems to harvest these stands. Also the study identifies areas of needed development for economically viable harvesting systems.

33895 **(SAND—86-7032) Development of dendritic web continuous ribbon silicon cells for use in a linear Fresnel lens photovoltaic concentrator.** O'Neill, M.J.; McDanal, A.J. (Entech, Inc., Dallas-Fort Worth Airport, TX (USA)). Apr 1986. Contract AC04-76DP00789. 37p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86011017.

The primary objective of this program was to design, develop, and test low-cost, continuous ribbon silicon cells suitable for use in ENTECH's linear Fresnel lens photovoltaic concenrator module. The cells were made by Westinghouse using a dendritic web continuous ribbon process. This program represented the first attempt to adapt dendritic web cell fabrication technology to concentrator applications. ENTECH generated an optimized cell design, which included variable metallization matched to the radiant flux profile of the linear Fresnel lens concentrator. Westinghouse fabricated cells in several sequential production runs. The cells were tested by ENTECH under actual lens illumination to determine their performance parameters. The best cells made under this program achieved peak cell efficiencies of about 14%, compared to about 16% for production cells made by Applied Solar Energy Corporation, using float-zone-refined single-crystal silicon. With additional development, significant performance improvements should be achievable in future dendritic web concentrator cells.

33896 **(SERI/STR—211-2858) Silane, disilane, and germane. 1985 update.** Lorenz, J.H. (Solar Energy Research Inst., Golden, CO (USA)). Feb 1986. Contract AC02-83CH10093. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86004437.

This report contains information on the quality of the monosilane, disilane, germane, germanium tetrafluoride, and silicon tetrafluoride now commerically available. Supplier's analyses and production capacity data are presented. User comments and some comparative analyses are tabulated. Prices and grades are listed for the compounds available in the United States and in Japan. Producers and sellers of these materials in the United States and Japan are listed with their addresses and product mix.

33897 **(SERI/STR—211-2910) Electrochemical photovoltaic cells: stabilization and optimization of semiconductor photoanodes. Final subcontract report, 5 July 1983-30 September 1985.** Haak, R.; Menezes, S. (Rockwell International Corp., Thousand Oaks, CA (USA). Science Center). Apr 1986. Contract AC02-83CH10093. 58p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86004450.

The overall objective of this program was to provide measurement support using electrochemical photocapacitance spectroscopy (EPS) to the SERI program and subcontractors. This work initially focused on the evaluation of polycrystalline II-VI thin-film photoelectrode materials, particularly the characterization of surface states at the semiconductor/electrolyte interface. The last year of work focused on the study of bulk and surface properties of $CuInSe_2$ and included an evaluation of single-crystal, polycrystal, and polycrystalline thin-film material as well as $CuInSe_2$/CdS-based thin-film devices.

33898 **(SERI/STR—211-2923) $CuInSe_2$ solar cell research by sputter depositon. Annual subcontract report, 1 December 1984-31 December 1985.** Thornton, J.A.; Lommasson, T.C.; Burnett, A.F. (Illinois Univ., Urbana (USA)). Apr 1986. Contract AC02-83CH10093. 75p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86004449.

This report describes subcontracted work on in-line sputtering equipment with a vacuum interlock and four deposition chambers configured for depositing $CuInSe_2$/CdS heterojunctions by reactive sputtering without breaking vaccum. The unit designed by Telic Corp., was installed and tested in the Coordinated Science Laboratory, University of Illinois. Characterization facilities were also assembled for measuring cell current-voltage characteristics in the dark and under illumination, and for making spectral response, capacitance-voltage, and optical absorption coefficient and band-gap measurements. Experiments were conducted to investigate two-layer $CuInSe_2$ coatings formed by depositing an In-rich top layer over a Cu-rich, two-phase (Cu_2Se-$CuInSe_2$) base layer. Solid state reactions during deposition appear to yield a nearly homogeneous chalcopyrite material. Deposition conditions can be selected that consistently yield compositions within the range required for device fabrication. Devices with efficiencies of 4 to 6% have been fabricated from this material.

33899 **Stable N-$CuInSe_2$/Iodine-Iodide photoelectrochemical cell.** Cahen, D.; Chen, Y.W. (to Dept. of Energy). US Patent 4,559,282. 17 Dec 1985. Filed date 20 Sep 1984. vp.

PAT-APPL-652396.

In a photoelectrochemical solar cell, stable output and solar efficiency in excess of 10% are achieved with a photoanode of n-$CuInSe_2$ electrode material and an iodine/iodide redox couple used in a liquid electrolyte. The photoanode is prepared by treating the electrode material by chemical etching, for example in Br_2/MeOH; heating the etched electrode material in air or oxygen; depositing a surface film coating of indium on the electrode material after the initial heating; and thereafter again heating the electrode material in air or oxygen to oxidize the indium. The electrolyte is treated by the addition of Cu^+ or Cu^{2+} salts and In^3 salts.

33900 **Method of synthesizing polymers from a solid electrolyte.** Skotheim, T. A. (to The United States of America as represented by the United States Department of Energy). US Patent 4,544,456. 1 Oct 1985. Filed date 19 Oct 1984. vp.

PAT-APPL-662657.

A method of synthesizing electrically conductive polymers from a solvent-free solid polymer electrolyte wherein an assembly of a substrate having an electrode thereon, a thin coating of solid electrolyte including a solution of PEO complexed with an alkali salt, and a thin transparent noble metal electrode are disposed in an evacuated chamber into which a selected monomer vapor is introduced while an electric potential is applied across the solid electrolyte to hold the thin transparent electrode at a positive potential relative to the electrode on the substrate, whereby a highly conductive polymer film is grown on the transparent electrode between it and the solid electrolyte.

33901 **Triplet spin dynamics of of bacteriochlorophyll-a from transient EPR lineshape analysis.** Gonen, O.; Regev, A.; Levanon, H.; Thurnauer, M.C.; Norris, J.R.; Closs, G.L. (Hebrew Univ., Jerusalem, Israel). *Chemical Physics Letters;* 113: No. 2, 117-122(11 Jan 1985). Contract W-31-109-ENG-38.

A study of the transient photoexcited triplet of bacteriochlorophyll-a in a glass matrix at 60 K utilizing light modulation EPR spectroscopy is reported. In view of widely deviating results for the triplet sublevel depopulation rates, this problem was engaged

via EPR lineshape analysis rather than direct kinetic measurements. This method also yields the relative population and spin-lattice relaxation rates. 12 references, 2 figure, 1 table.

1406 Photovoltaic Power Systems

REFER ALSO TO CITATION(S) 33893

1407 Solar Thermal Power Systems

33902 **(SAND—85-8019) Review of thermal loss evaluations of solar central receivers.** Boehm, R.F. (Sandia National Labs., Livermore, CA (USA)). Apr 1986. Contract AC04-76DP00789. 38p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86010779.

This paper summarizes previous evaluations of thermal losses from solar central receivers. Two types of evaluations have been done: (1) efficiency tests, which use performance data, and (2) loss tests which infer losses directly. In either type or evaluation, the radiation loss must first be calculated. This study also reviews the techniques used for calculating these radiation losses. Special attention is given to physical parameters such as Grashof or Raleigh number and Reynolds number. Thermal loss uncertainties and predictions are also studied. Finally, this report draws a number of conclusions and makes recommendations for further study.

33903 **(SAND—85-8181) Molten salt electric experiment steam generator subsystem. Final report.** (Babcock and Wilcox Co., Barberton, OH (USA). Nuclear Equipment Div.). Apr 1986. Contract AC04-76DR00789. 334p. NTIS, PC A15/MF A01; 1; GPO Dep. File Number DE86011380.

The Molten Salt Electric Experiment (MSEE) is a full-system demonstration of a solar central receiver power generation plant which uses molten nitrate salt as the primary heat transfer fluid and also as the thermal storage medium. The MSEE receiver has a thermal capacity of 5 MWt, and the turbine-generator is rated at 750 kWe. The system has a two-tank thermal storage subsystem with a capacity of 6 MW-hours, and a steam generator rated at 3.1 MWt. The MSEE began in mid-1982, and testing was completed in July 1985 at the Central Receiver Test Facility in Albuquerque, New Mexico. Babcock and Wilcox was awarded the contract to supply a steam generator for the MSEE capable of producing superheated steam using molten salt as a heat source. This report covers the design, fabrication, installation, and testing of the Steam Generation Subsystem beginning in September 1982 and ending in June 1984.

33904 **(SERI/SP—273-2938) Solar thermal energy systems. Program summary, fiscal year 1985.** (Sandia National Labs., Albuquerque, NM (USA); Sandia National Labs., Livermore, CA (USA); Solar Energy Research Inst., Golden, CO (USA)). Apr 1986. Contract AC02-83CH10093;AC04-76DR00789;AC04-76DP00789. 159p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE86004441.

The research and development (R & D) described in this document was conducted within the US Department of Energy's (DOE) Solar Thermal Technology Program. The goal of the Solar Thermal Technology Program is to advance the engineering and scientific understanding of solar thermal technology, and to establish the technology base from which private industry can develop solar thermal power production options for introduction into the competitive energy market. Research areas emphasized include central receivers, distributed receivers and solar thermal materials. This program summary highlights tasks conducted by the participating national laboratories under contract by industrial, academic, or other research institutions. This summary covers activities initiated, renewed, or completed during Fiscal Year 1985 (October 1, 1984 through September 30, 1985). This document includes introductory information, a list of directing organizations, a list of acronyms and abbreviations, and an index of current contractors. It also includes individual activity summary sheets, grouped by directing organizations and a list of FY 1985 publications.

33905 **(SERI/STR—217-2915) Economic evaluation of Air Force Academy third-party contract for solar heat. A consultant report.** Sklar, H. (Solar Energy Research Inst., Golden, CO (USA)). May 1986. Contract AC02-83CH10093. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86004459.

In 1982 the US Air Force Academy decided to add a solar thermal system to its main heating plant. The Academy decided to use a third-party contracting arrangement under which it would buy the energy produced by a plant owned and operated by a contractor. In conjunction with the preparation of a request for proposals, the Academy asked the Solar Energy Research Institute to assist in the technical and economic evaluation of the proposed plant. In 1983 the Academy negotiated a draft contract for the solar thermal plant and began obtaining necessary approvals. In 1984 the Academy asked SERI to do an economic evaluation of the draft contract. This report represents the results of that evaluation.

1408 Ocean Energy Systems

33906 **(SERI/SP—271-2796) Environmental impacts of ocean thermal energy conversion.** (Solar Energy Research Inst., Golden, CO (USA)). Apr 1986. Contract AC02-83CH10093. 42p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85012168.

Ocean thermal energy conversion (OTEC) is a promising technology for production of energy and usable by-products from solar-generated temperature gradients in the world's oceans. Although considered benign compared to alternative forms of energy generation, deployment of OTEC plants will result in interactions with marine, terrestrial, and atmospheric environments and in socioeconomic interactions with surrounding areas. The Ocean Energy Technology Program of the Department of Energy has funded research to improve the understanding of these interactions. No insurmountable environmental obstacle to OTEC deployment has been uncovered. This document contains a summary of that research for entrepreneurs, utility engineers, and others interested in pursuing OTEC's potential. In addition, it provides a guide to permits, regulations, and licenses applicable to construction of an OTEC plant.

1409 Solar Thermal Utilization

33907 **(GRES—1985) GRES 1985 annual report.** (Ecole Polytechnique Federale, Lausanne (Switzerland). Groupe de Recherche en Energie Solaire). 1985. 25p. (In French and English). NTIS (US Sales Only), PC A02/MF A01. File Number DE86901421.

During the last ten years, considerable progress has been made in the use of passive solar energy. Whereas the first research projects in this field were concerned essentially with the problem of collection systems, the emphasis is now on a global building approach which incorporates the building fabric (envelope, structure, etc.), its technical equipment (heating, ventilation, hot water and electrical networks) and how the building is used by its occupants (residential, industrial, commercial, etc.). The research plans of GRES reflect these developments in the scale and content of passive solar energy work. The dynamic thermal behavior of buildings is now considered in conjunction with the passive use of solar energy, both of which are closely related to building energetics.

33908 **Long term performance of a commercial solar dryer.** Carnegie, E.J. (Agricultural Eng. Dept., California Polytechnic State Univ., San Luis Obispo, CA). *ASAE (American Society of Agricultural Engineers) Technical Paper;* No. 4546, 10(1985). (CONF-841278—).

From Winter meeting of the American Society of Agricultural Engineers; New Orleans, LA, USA (11 Dec 1984).

In 1976 ERDA now known as DOE funded the design and construction of a 22,000 sq. ft. solar collector system with 700 tons of rock storage and a heat recovery wheel. This system was placed in operation in April of 1978 and has operated and been monitored

each drying season since. This paper will cover the operation and required maintenance since its installation.

1410 Solar Collectors And Concentrators

REFER ALSO TO CITATION(S) 33332

33909 (ANL—86-16) **Analysis of heat-pipe absorbers in evacuated-tube solar collectors.** Hull, J.R.; Schertz, W.W.; Allen, J.W. (Argonne National Lab., IL (USA)). Feb 1986. Contract W-31-109-ENG-38. 46p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86010764.

Heat transfer in evacuated-tube solar collectors with heat-pipe absorbers is compared with that for similar collectors with flow-through absorbers. In systems that produce hot water or other heated fluids, the heat-pipe absorber suffers a heat transfer penalty compared with the flow-through absorber, but in many cases the penalty can be minimized by proper design at the heat-pipe condenser and system manifold. The heat transfer penalty decreases with decreasing collector heat loss coefficient, suggesting that evacuated tubes with optical concentration are more appropriate for use with heat pipes than evacuated or nonevacuated flat-plate collectors. When the solar collector is used to drive an absorption chiller, the heat-pipe absorber has better heat transfer characteristics than the flow-through absorbers.

33910 (CONF-8312130—, pp 27-42) **Accelerated testing of absorber materials.** Wennerholm, H. (National Testing Institute, Boras, Sweden). Aug 1984. NTIS, PC A08/MF A01. File Number DE86006907.

From 3. IEA task workshop on service life of solar collector components and materials; Lyngby, Denmark (6 Dec 1983).

A study was performed to aid in the development of accelerated test methods needed for evaluation and certification (or approval) of absorber materials. Preliminary results are presented of the research concerning accelerated testing. Tasks were performed to identify performance requirements, develop test methods to evaluate performance and durability according to the requirements, perform laboratory and field evaluations to ensure that mechanisms of failure in accelerated tests are the same as those to be expected in actual service, and to develop draft standards. 12 tables.

33911 (CONF-8312130—, pp 43-50) **Comparison and assessment of outdoor and indoor laboratory exposure tests for flat-plate solar collector absorber and cover materials.** Waksman, D. (National Bureau of Standards, Washington, DC). Aug 1984. NTIS, PC A08/MF A01. File Number DE86006907.

From 3. IEA task workshop on service life of solar collector components and materials; Lyngby, Denmark (6 Dec 1983).

Eight different types of flat-plate solar collectors representative of those in use at that time, were exposed outdoors at four sites located in different climatic regions. Small scale cover and absorber materials coupon specimens consisting of samples taken from a collector of each of the eight types used and a number of additional materials were exposed concurrently with the full-size collectors. Periodic measurements were made of specimen performance as a function of exposure time. Indoor laboratory aging tests were conducted concurrently on specimens of the same materials to provide a basis for comparison with the outdoor exposure tests. Outdoor exposure conditions at the materials coupon specimen level included real time exposure in simulated collectors and exposure to concentrated sunlight in machines described in ASTM E 838. Indoor laboratory tests conducted included exposure to: temperature, combined temperature and humidity, combined temperature and radiation, and thermal cycling (absorber materials only). Cover materials investigated included: poly(ethylene terephthalate), polycarbonate, poly(vinyl fluoride), poly(methyl methacrylate), fluorinated (ethylene propylene) copolymer and several types of glass fiber reinforced plastics. Absorptive coatings studied included black nickel, black chrome of several types of substrates, copper oxide, lead oxide, aluminum oxide, anodized and conversion coatings, black porcelain enamel, and several types of flat black paints. Changes in the optical properties of these materials were measured as a function of exposure time. Visual observations of changes in appearance were made and microstructural studies were conducted on materials showing visible signs of degradation. 7 references, 5 tables.

33912 (CONF-8312130—, pp 51-54) **Research on durability of solar absorber and cover plate materials at the National Research Council of Canada.** Yamasaki, R.S. (National Research Council of Canada, Ottawa, Ontario). Aug 1984. NTIS, PC A08/MF A01. File Number DE86006907.

From 3. IEA task workshop on service life of solar collector components and materials; Lyngby, Denmark (6 Dec 1983).

To generally characterize the microenvironment of absorbers and cover plates, single- and double- glazed collectors were instrumented and monitored during exposure at S/60° at Ottawa under separate simulated space-heating and stagnation conditions. Weathering factors which are believed to be deleterious were determined for a period of one year. In addition, test specimens of 15 absorbers of various coating-substrate combinations were exposed, by attachment to an absorber plate, in double-glazed collectors. Exposure studies are being carried out under controlled laboratory conditions to identify those outdoor collector conditions which are most deleterious to the absorber and cover plate materials. 2 tables.

33913 (CONF-8312130—, pp 55-60) **Proposal for standardized testing of solar collector coatings.** Andersen, P. (Technological Institute, Taastrup, Denmark). Aug 1984. NTIS, PC A08/MF A01. File Number DE86006907.

From 3. IEA task workshop on service life of solar collector components and materials; Lyngby, Denmark (6 Dec 1983).

In connection with participation in international cooperation programs, Denmark has been asked to contribute a proposal for testing of solar collector coatings. The test procedure is presented in table form; it specifies temperature and exposure time scenarios. ASTM standardized procedures are identified where they are applicable. 2 tables.

33914 (CONF-8312130—, pp 61-70) **Durability tests of solar absorptive coatings.** Frei, U.; Keller, J. (Technical High school, Rapperswil, Switzerland). Aug 1984. NTIS, PC A08/MF A01. File Number DE86006907.

From 3. IEA task workshop on service life of solar collector components and materials; Lyngby, Denmark (6 Dec 1983).

Within the framework of the Swiss research program Reliability and Durability of Solar Energy Systems, 19 different absorber samples have been exposed to accelerated temperature and humidity tests as well as to an outdoor test under natural meteorological conditions. Some of the samples are cut from collectors identical to those subjected to a stagnation test of two years duration. Before and after the exposure of the samples the absorbance and the emittance of the coating as well as its mechanical resistance (adhesion) were measured. Photographs and scanning electron microscope pictures were taken. The results of the experiments show that generally high temperatures (200°C) as well as the combined influence of temperature and humidity produce the most pronounced degradation. Furthermore, selective coatings with rather high emittances (i.e. 20% < epsilon < 50%) are substantially less stable than well made, selective or non selective coatings. 2 references, 5 figures, 1 table.

33915 (CONF-8312130—, pp 71-92) **Preliminary stochastic model for service life prediction of a photolytically and thermally degraded polymeric cover plate material.** Martin, J.W.; Waksman, D.; Bentz, D.P.; Lechner, J.A.; Dickens, B. (National Bureau of Standards, Washington, DC). Aug 1984. NTIS, PC A08/MF A01. File Number DE86006907.

From 3. IEA task workshop on service life of solar collector components and materials; Lyngby, Denmark (6 Dec 1983).

A preliminary stochastic model has been developed and partially validated for predicting the service life of a polymeric film, such as poly(methyl methacrylate) (PMMA), which is subjected to both thermal and photolytic degradation. The exposure-conditions under which degradation is induced simulate those expected for a polymeric cover plate material in an active solar collector. Service life for a population of films is defined as that time beyond which an unacceptable portion of the population fails. The criterion used

for failure of a film is that its number average molecular weight has fallen below a specified threshold value. 23 references, 3 figures.

33916 (CONF-8312130—, pp 93-98) **Outdoor exposure trials as indicators of collector durability.** Brinkworth, B.J.; Cross, B.M. (Univ. College, Cardiff, Wales). Aug 1984. NTIS, PC A08/MF A01. File Number DE86006907.

From 3. IEA task workshop on service life of solar collector components and materials; Lyngby, Denmark (6 Dec 1983).

Stagnation tests for solar collectors are briefly described and evaluated. The most frequently-observed types of degradation are described. The changes needed to make stagnation tests more closely simulate real-world conditions are briefly discussed.

33917 (CONF-8312130—, pp 99-104) **Test procedures for thermal collectors used at the Joint Research Centre, Ispra.** Riesch, G. (Joint Research Centre, Ispra, Italy). Aug 1984. NTIS, PC A08/MF A01. File Number DE86006907.

From 3. IEA task workshop on service life of solar collector components and materials; Lyngby, Denmark (6 Dec 1983).

The work at the JRC, Ispra on the durability of thermal collectors comprises tests in the following fields: destructive failures, slow efficiency degradations, outer corrosion, and inner corrosion. Brief descriptions of tests and results are presented for work on resistance of absorbers to overpressure, leak tightness, resistance to life loads, hail tests and thermal shock tests.

33918 (CONF-8312130—, pp 105-112) **Results of slow efficiency decrease tests made at the Joint Research Centre, Ispra.** Riesch, G. (Joint Research Centre, Ispra, Italy). Aug 1984. NTIS, PC A08/MF A01. File Number DE86006907.

From 3. IEA task workshop on service life of solar collector components and materials; Lyngby, Denmark (6 Dec 1983).

In the field of slow efficiency degradation of solar collectors the following are made: test for water tightness, exposure to ultraviolet irradiation, exposure to sun and weather in dry conditions (outdoors), and exposure to simulated sun (indoor exposure). Brief descriptions of the test procedures in each of these areas are presented. Recommendations for design changes which have resulted from these test programs are made.

33919 (CONF-8312130—, pp 113-118) **Development of practical methods for the determination of the stagnation temperature and the durability of solar collectors.** Wenzel, H. (TOV Bayern, Muenchen, West Germany). Aug 1984. NTIS, PC A08/MF A01. File Number DE86006907.

From 3. IEA task workshop on service life of solar collector components and materials; Lyngby, Denmark (6 Dec 1983).

6 different types of flat plate solar collectors were exposed outdoors in Munich. Stagnation temperatures and degradation were monitored. The results of the tests are displayed in chart and graph form, and are briefly discussed. No correlation was found between the hours of sunshine and stagnation temperature or ambient air temperature and stagnation temperature.

33920 (CONF-8312130—, pp 119-122) **Indoor test procedures for the durability of solar collectors, as presently used in the Netherlands.** Koelimij, A. (TNO, Netherlands). Aug 1984. NTIS, PC A08/MF A01. File Number DE86006907.

From 3. IEA task workshop on service life of solar collector components and materials; Lyngby, Denmark (6 Dec 1983).

The test program for solar collectors begins with an assessment of the properties of the collector, including: measurement of the air leakage through the collector; determination of the efficiency curve of the collector; and determination of raintightness of the collector. Thermal loading tests are then carried out, including: a stagnation test followed by test of resistance of the collector to temperature shock; a test of resistance of the collector to thermal cycling at high temperatures; a test of the resistance of the cover to temperature shock; and exposure to frost and thaw cycles. A brief description of each of the tests is presented.

33921 (CONF-8312130—, pp 123-128) **Prevention of corrosion-, scale-formation and fouling-damage in low- and medium-temperature closed loop collector systems.** Bruck, M. (Austrian Solar and Space Agency, Vienna). Aug 1984. NTIS, PC A08/MF A01. File Number DE86006907.

From 3. IEA task workshop on service life of solar collector components and materials; Lyngby, Denmark (6 Dec 1983).

This report gives a short overview of the state of the art of the ongoing corrosion activities of the solar group of the Austrian Standards Institute. The engineering characteristics of low and medium temperature closed loop collector systems are presented. The problems with such systems are defined, including: corrosion, scale, and fouling. Recommendations are made to prevent corrosion-, scale-, and fouling-induced damage. 6 references.

33922 (CONF-8312130—, pp 130-135) **EIR solar heating plant corrosion surveillance program.** Wiedemann, K.H. (Swiss Federal Institute for Reactor Research, Wuerenlingen). Aug 1984. NTIS, PC A08/MF A01. File Number DE86006907.

From 3. IEA task workshop on service life of solar collector components and materials; Lyngby, Denmark (6 Dec 1983).

At the start of the program the composition of the coolant was 65 Vol. % deionized water, 35 Vol. % ethylenglycol, and 15 g/l inhibitor. This composition remained practically constant. The metal contents of the coolant samples show large differences, because of deposits of metal containing precipitates, the amount of them being temporal and locally different; p/sub H/ and electrical conductivity remained practically constant. Therefore, corrosion in the circuit cannot be recorded by p/sub H/ or electrical conductivity readings or by chemical analysis of coolant samples. The metal losses at the material samples in the by-pass determined after two years were: aluminum ca. 70 μm; mild steel St 37 ca. 0.3 μm; red brass RG-5 ca. 0.4 μm; stainless steel Cr Ni 18 10 ca. 0.1 μm. The greatest quantity of the metal loss occurred during the first year and increased only slightly during the second year. Pitting corrosion has not been observed on any material. 2 figures, 1 table.

33923 (CONF-8312130—, pp 137-146) **Improvement of reliability, durability and expected lifetime for solar collector systems.** Pedersen, P.V. (Technical Univ. of Denmark, Lyngby). Aug 1984. NTIS, PC A08/MF A01. File Number DE86006907.

From 3. IEA task workshop on service life of solar collector components and materials; Lyngby, Denmark (6 Dec 1983).

The IEA cooperative work is described. The work in Denmark up to now has been grouped into three main activities: compilation and analysis of operational experience with solar collector systems; development of accelerated material tests and service life testing; and development of complete collector tests. Means for estimating the useful lifetime of solar collector systems are briefly discussed. Some of the results of 52 IEA solar collector system inspections are presented. Fairly detailed descriptions of the tests performed are presented. 8 references, 3 figures.

33924 (CONF-8312130—, pp 147-152) **Condensation problems with roof integrated solar collectors in climates in northern countries.** Pedersen, P.V. (Technical Univ. of Denmark, Lyngby). Aug 1984. NTIS, PC A08/MF A01. File Number DE86006907.

From 3. IEA task workshop on service life of solar collector components and materials; Lyngby, Denmark (6 Dec 1983).

As part of the Danish Department of Energy's Solar Energy Research Program, work has been initiated at the Thermal Insulation Laboratory to look at different aspects in connection with the general problem of condensation in solar collectors. Continuous inspection of solar collectors in stagnation and operation and measurements of temperatures and humidity of solar collectors have been carried out at the laboratory's research area. Some important aspects to be aware of if serious problems with condensation in solar collectors are to be avoided are: a rain tight solar collector construction is necessary; construction should always have a built-in possibility of ventilation; solar collectors which are built into the roof should always be ventilated with only outside air; ventilation holes only at the bottom of the solar collector construction is not enough if one wants to make use of the chimney effect; and built-in drain holes should be incorporated into the design of solar collectors. 1 figure.

33925 (SERI/TR—253-2736) Single, stretched membrane, structural module experiments. Wood, R.L. (Solar Energy Research Inst., Golden, CO (USA)). Feb 1986. Contract AC02-83CH10093. 58p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86004433.

This report describes tests done on stretched-membrane heliostats used to reflect solar radiation onto a central receiver. The tests were used to validate prior analysis and mathematical models developed to describe module performance. The modules tested were three meters in diameter and had reflective polymer film laminated to the membrane. The frames were supported at three points equally spaced around the ring. Three modules were pneumatically attached with their weight suspended at the bottom support, two were pneumatically attached with their weight suspended from the upper mounts, and one was rigidly attached with its weight suspended at the bottom mount. By varying the membrane tension we could simulate a uniform wind loading normal to the mirror's surface. A video camera 15+ meters away from the mirror recorded the virtual image of a target grid as reflected by the mirrors' surface. The image was digitized and stored on a microcomputer. Using the law of reflection and analytic geometry, we computed the surface slopes of a sampling of points on the surface. The dominant module response was consistent with prior SERI analyses. The simple analytical model is quite adequate for designing and sizing single-membrane modules if the initial imperfections and their amplification are appropriately controlled. To avoid potential problems resulting from the fundamentally n = 2 deformation phenomena, we advise using either relatively stiffer ring frames or more than three support points.

33926 Analysis of heat transfer factors for a heat pipe absorber array connected to a common manifold. Hull, J.R. (Argonne National Laboratory, Argonne, IL 60439). *Journal of Solar Energy Engineering;* **108**: No. 1, vp(Feb 1986). Contract W-31-109-ENG-38.

Heat transfer factors and thermal efficiency are calculated for a heat pipe absorber array connected to a common manifold. Arrays with less than ten heat pipes are shown to have significantly less efficiency than a conventional flow-through collector. Efficiency is also sensitive to the heat transfer rate per unit temperature difference from the heat pipe fluid to the manifold fluid divided by that from the heat pipe surface to the ambient, with maximum efficiency occurring for ratios greater than 100.

33927 The NBS Solar Collector Reliability/Durability Test Program: Summary of results and recommendations for collector testing. Waksman, D.; Thomas, W.C. (Center for Building Technology, National Bureau of Standards, Gaithersburg, MD 20899). *Journal of Solar Energy Engineering;* **108**: No. 1, vp(Feb 1986).

Efforts in the development of reliability/durability tests for solar collectors and their materials have been hampered by the lack of real time and accelerated degradation data that can be correlated with in-use conditions. In 1977, the Solar Collector Reliability/Durability Test Program was initiated by the U.S. Department of Energy at the National Bureau of Standards (NBS) to help generate the data required to develop methods for predicting the long term durability and reliability of flat-plate solar collectors and their materials. This paper summarizes the results obtained in the test program for full-size solar collectors. Recommendations are made regarding the use and limitations of thermal performance measurements and environmental exposure tests for assessing the durability of flat-plate solar collectors.

33928 Parametric study of salt gradient solar ponds. Beniwal, R.S.; Saxena, N.S.; Bhandari, R.C. (Thermal Physics Laboratory, Department of Physics, University of Rajasthan, Jaipur 302004). *Journal of Solar Energy Engineering;* **108**: No. 1, vp(Feb 1986).

A mathematical model for efficiency of a salt gradient solar pond is described. Heat losses from the bottom of the pond have been calculated, and the results for the effective thermal conductivity with the thicknesses of various insulating materials have been presented. The effect of the ground thermal resistance on the efficiency of the pond for different values of $\Delta T/S^0$ are also shown.

33929 Thin film absorber for a solar collector. Wilhelm, W. G. (to US DOE). US Patent 4,559,924. 24 Dec 1985. Filed date 27 Feb 1984. vp.

PAT-APPL-582163.

This invention pertains to energy absorbers for solar collectors, and more particularly to high performance thin film absorbers. The solar collectors comprising the absorber of this invention overcome several problems seen in current systems, such as excessive hardware, high cost and unreliability. In the preferred form, the apparatus features a substantially rigid planar frame with a thin film window bonded to one planar side of the frame. An absorber in accordance with the present invention is comprised of two thin film layers that are sealed perimetrically. In a preferred embodiment, thin film layers are formed from a metal/plastic laminate. The layers define a fluid-tight planar envelope of large surface area to volume through which a heat transfer fluid flows. The absorber is bonded to the other planar side of the frame. The thin film construction of the absorber assures substantially full envelope wetting and thus good efficiency. The window and absorber films stress the frame adding to the overall strength of the collector.

33930 Cable tensioned membrane solar collector module with variable tension control. Murphy, L.M. (to Dept. of Energy). US Patent 4,552,438. 12 Nov 1985. Filed date 9 Jan 1984. vp.

PAT-APPL-569085.

Disclosed is a solar collector comprising a membrane for concentrating sunlight, a plurality of elongated structural members for suspending the membrane member thereon, and a plurality of control members for adjustably tensioning the membrane member, as well as for controlling a focus produced by the membrane members. Each control member is disposed at a different corresponding one of the plurality of structural members. The collector also comprises an elongated flexible tensioning member, which serves to stretch the membrane member and to thereafter hold it in tension, and a plurality of sleeve members, which serve to provide the membrane member with a desired surface contour during tensioning of the membrane member. The tensioning member is coupled to the structural members such that the tensioning member is adjustably tensioned through the structural members. The tensioning member is also coupled to the membrane member through the sleeve members such that the sleeve members uniformly and symmetrically stretch the membrane member upon applying tension to the tensioning member with the control members.

1420 Heat Storage

REFER ALSO TO CITATION(S) 33903

15 GEOTHERMAL ENERGY

1501 Resource Status And Assessment

REFER ALSO TO CITATION(S) 33937

33931 (DOE/ER/10082—T1-Vol.1) Exploration for geothermal resources in the Capital District of New York. Volume 1. Final report. (Dunn Geoscience Corp., Latham, NY (USA)). Nov 1981. Contract FG05-79ER10082. 160p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE86010649.

Water chemistry, gas analyses, and geophysical methods including gravity and magnetic surveys, microseismic monitoring, and temperature gradient measurements were used in the Capital District area to evaluate the potential for a hydrothermal geothermal system. Water and gas chemistries provided indirect indicators, and temperature gradients provided direct indications of a geothermal system. Gravity results were supportive of gradient and chemistry data, but seismic and magnetic work have thus far provided little information on the potential system. Gradients throughout the area ranged from an average background value of about 10°C/km to a high of roughly 44°C/km. The highest gradient values, the most unusual water chemistries and largest carbon dioxide exhala-

tions occur along the Saratoga and McGregor faults between Saratoga Springs and Schenectady, and indicate a good potential for a usable hydrothermal geothermal system at depth.

33932 **(DOE/ER/10082—T1-Vol.2) Heat flow and subsurface temperature distributions in central and western New York. Volume 2.** Hodge, D.S.; Fromm, K.A. (State Univ. of New York, Buffalo (USA). Dept. of Geological Sciences). Aug 1982. Contract FG05-79ER10082. 187p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE86010650.

Existing data in western and central New York indicates the possibility of a low-temperature, direct-use geothermal resource. This report evaluates the heat flow and provides a representation of temperatures at depth in this area. This has been done by: (1) analyzing known temperature distributions, (2) measuring the thermal conductivity of sedimentary rock units. Based on this information, areas of higher-than-normal heat flow and temperatures in possible geothermal source reservoirs are described to aid in targeting areas for the exploitation of geothermal energy in New York.

33933 **(DOE/ER/10082—T1-Vol.4) Exploration and drilling for geothermal heat in the Capital District, New York. Volume 4. Final report.** (Dunn Geoscience Corp., Latham, NY (USA)). Aug 1983. Contract FG05-79ER10082. 173p. (PB—84-153162). NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE86010652.

The Capital District area of New York was explored to determine the nature of a hydrothermal geothermal system. The chemistry of subsurface water and gas, the variation in gravity, magnetism, seismicity, and temperature gradients were determined. Water and gas analyses and temperature gradient measurements indicate the existence of a geothermal system located under an area from Ballston Spa, southward to Altamont, and eastward toward Albany. Gravimetric and magnetic surveys provided little useful data but microseismic activity in the Altamont area may be significant. Eight wells about 400 feet deep, one 600 feet and one 2232 feet were drilled and tested for geothermal potential. The highest temperature gradients, most unusual water chemistries, and greatest carbon dioxide exhalations were observed in the vicinity of the Saratoga and McGregor faults between Saratoga Springs and Schenectady, New York, suggesting some fault control over the geothermal system. Depths to the warm fluids within the system range from 500 meters (Ballston Spa) to 2 kilometers (Albany).

1503 Geothermal Exploration And Exploration Technology

REFER ALSO TO CITATION(S) 33931, 33931, 34856

33934 **(DOE/ER/10082—T1-Vol.3) Evaluation of potential geothermal reservoirs in central and western New York State. Volume 3. Final report.** (Syracuse Univ., NY (USA). Dept. of Geology). Jun 1983. Contract FG05-79ER10082. 80p. (PB—83-252098). NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86010651.

Computer processed geophysical well logs from central and western New York State were analysed to evaluate the potential of subsurface formations as a source for low-temperature geothermal water. The analysis indicated that porous sandstone sections at the top of the Ordovician Theresa Formation and at the base of the Cambrian Potsdam Formation have the required depth, porosity, and permeability to act as a source for geothermal fluids over a relatively large area in the central part of the state. The fluid potential plus an advantageous geothermal gradient and the results of the test well drilled in the city of Auburn in Cayuga County suggest that low temperature geothermal energy may ba a viable alternative to other more conventional forms of energy that not indigenous to New York State.

33935 **(DOE/ER/10082—T1-Vol.5) Microseismic monitoring for evidence of geothermal heat in the capital district of New York. Volume 5. Phases I-III. Final report.** (New York State Museum and Science Service, Albany (USA)). Jun 1983. Contract FG05-79ER10082. 57p. (PB—83-248807). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86010653.

The seismic monitoring aspect of this work consisted of setting up and operating a network of seven seismograph stations within and around the study area capable of detecting and locating small earthquakes. To supplement the evidence from present day seismic activity, a list of all known historical and early instrumental earthquakes was compiled and improved from original sources for a larger region centered on the study area. Additional field work was done to determine seismic velocities of P and S phases by special recording of quarry blasts. The velocity results were used both as an aid to improve earthquake locations based on computer programs and to make inferences about the existence of temperature anomalies, and hence geothermal potential, at depths beneath the study area. Finally, the level in the continuous background earth vibration, microseisms, was measured throughout the study area to test a possibility that a relationship may exist at the surface between the level in microseisms and the geothermal or related activity. The observed seismic activity within the study area, although considerably higher (two to three times) than inferred from the historical and early instrumental data, is still not only low for a potential geothermal area but appears to be related to coherent regional tectonic stresses and not to the proposed more localized geothermal activity reflected in the mineralized, CO_2 rich spring discharge.

33936 **(DOE/ET/27243—T1) Geothermal gradient drilling, north-central Cascades of Oregon, 1979.** Youngquist, W. (Oregon State Dept. of Geology and Mineral Industries, Portland (USA)). 1980. Contract FG06-79ET27243. 51p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86010573.

A geothermal gradient drilling program was conducted on the western flank of the north-central Cascade Mountains in Oregon. Six wells were drilled during this program, although in effect seven were drilled, as two wells were drilled at site 3, the second well, however, actually going to a lesser depth than the first. Three of the wells (3, 4, and 5) were drilled in areas which topographically are subject to strong throughflows of ground water. None of these wells reached the regional water table, and all showed essentially isothermal geothermal gradients. The single well which was started essentially at the water table (well 6) shows a linear temperature rise with depth essentially from the top of the well bore. Well No. 2 shows an isothermal gradient down to the level of the regional water table and then shows a linear gradient of about 70°C/km from the regional water table to total depth.

33937 **(LA—10659-HDR-Vol.2) Exploration for hot dry rock geothermal resources in the Midcontinent USA. Hot dry rock conceptual models for exploration, HDR test site investigations, and the Illinois Deep Drill Hole Project. Volume 2.** Hinze, W.J.; Braile, L.W.; von Frese, R.R.B.; Lidiak, E.G.; Denison, R.E.; Keller, G.R.; Roy, R.F.; Swanberg, C.A.; Aiken, C.L.V.; Morgan, P. (Los Alamos National Lab., NM (USA)). Feb 1986. Contract W-7405-ENG-36. 133p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE86008160.

Three potential sources of HDR, each covering approximately a 2° x 2° area, were identified and subjected to preliminary evaluation with ad hoc exploration strategies. In the Mississippi Embayment test site, lateral thermal conductivity variations and subcrustal heat sources may be involved in producing abnormally high subsurface temperatures. Studies indicate that enhanced temperatures are associated primarily with basement rift features where vertical displacement of aquifers and faults cause the upward migration of hot waters leading to anomalously high, local, upper crustal temperatures. The Western Nebraska test site is a potential low temperature HDR source also related, at least in part, to groundwater movement. There appear to be much more widespread possibilities for similar HDR sites in the Great Plains area. The Southeast Michigan test site was selected for study because of the possible presence of radiogenic plutons overlain by a thickened sedimentary blanket. There is no direct information on the presence of abnormally high temperatures in this area, but the study does show that a combination of gravity and magnetic anomaly mapping with regional geological information derived from sparse drill holes in the Phanerozoic rocks is useful on a widespread basis for focusing on local areas for detailed evaluation.

33938 (NYSERDA—84-18-Vol.6) **Auburn low-temperature geothermal well. Volume 6. Final report.** Lynch, R.S.; Castor, T.P. (Donohue, Anstey and Morrill, Boston, MA (USA); ENG, Inc., Boston, MA (USA)). Dec 1983. Contract FG05-79ER10082. 281p. NTIS, PC A13/MF A01; 1; GPO Dep. File Number DE86010654.

The Auburn well was drilled to explore for low temperature geothermal resources in central New York State. The Auburn site was selected based on: its proximity to the Cayuga County anomaly (30°C/km), its favorable local geological conditions and the potential to provide hot water and space heating to two educational facilities. The well was drilled to a total depth of 5250 feet and into the Pre-Cambrian Basement. The well was extensively logged, flow and stress tested, hydraulically stimulated, and pump (pressure transient analysis) tested. The low-temperature geothermal potential was assessed in terms of: geological environment; hydrological conditions; reservoir characteristics; and recoverable hydrothermal reserves. The average geothermal gradient was measured to be as high as 26.7°C/km with a bottom-hole temperature of 126° +- 1°F. The proved volumetric resources were estimated to be 3.0 x 10^6 stock tank barrels (STB) with a maximum initial deliverability of ~11,600 STB/D and a continuous deliverability of ~3400 STB/D. The proved hydrothermal reserves were estimated to be 21.58 x 10^{10} Btu based on a volumetric component (4.13 x 10^{10} Btu), and a reinjection component (17.45 x 10^{10} Btu). The conclusion was made that the Auburn low-temperature reservoir could be utilized to provide hot water and space heating to the Auburn School District.

33939 **Thermal well-test method.** Tsang, C. F.; Doughty, C. A. (to US DOE). US Patent 4,559,818. 24 Dec 1985. Filed date 24 Feb 1984. vp.

PAT-APPL-583451.

A well-test method involving injection of hot (or cold) water into a groundwater aquifer, or injecting cold water into a geothermal reservoir. By making temperature measurements at various depths in one or more observation wells, certain properties of the aquifer are determined. These properties, not obtainable from conventional well test procedures, include the permeability anisotropy, and layering in the aquifer, and in-situ thermal properties. The temperature measurements at various depths are obtained from thermistors mounted in the observation wells.

1506 Environmental Aspects And Waste Disposal

33940 (DOE/ID/12079—133) **Applications of geochemistry to problems in geothermal injection.** Wright, P.M. (Utah Univ. Research Inst., Salt Lake City (USA). Earth Sciences Lab.). Feb 1985. Contract AC07-79ID12079. 43p. (ESL—85034-TR). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86009897.

Conventional reservoir engineering studies have, in the past, dealt mainly with interpretation of pressure transient effects in a reservoir. Present-day techniques can be used in many reservoirs to forecast with some reliability the probability, magnitude and timing of pressure interference among wells. However, forecasting fluid breakthrough from an injection well to a production well in geologically complex geothermal reservoirs is not presently possible with any reliability, and forecasting thermal breakthrough is even more difficult. In addition, the chemical effects of injection are poorly understood at present, and it is not possible to predict beforehand the full range of scaling and aquifer plugging problems that may be encountered. This report discusses development of chemical tracers specifically designed for geothermal applications so that breakthrough of injectate can be detected early, and field and laboratory studies on the chemical interactions among reservoir fluids, reservoir rocks and injected fluids so that these interactions can be quantified and models developed for predicting any degradation (or enhancement) of permeability.

1509 Geothermal Engineering

REFER ALSO TO CITATION(S) 33720

33941 (BNL—51960) **Characteristics of high temperature cementitious lost-circulation control materials for geothermal wells.** Sugama, T.; Kukacka, L.E.; Galen, B.G.; Milestone, N.B. (Brookhaven National Lab., Upton, NY (USA)). Jan 1986. Contract AC02-76CH00016. 42p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86010866.

Materials systems have been formulated for the in situ conversion of water-based bentonite drilling fluids into cementitious lost-circulation control materials (CLCM) for use in geothermal wells at temperatures up to 300°C. The formulations consist of a cement hardener, a borax admixture, and a fiber glass bridging material which are added to the bentonite fluids. Evaluations of the properties of the slurry and the cured CLCMS revealed that the ions supplied by dissociation of the borax in the CLCM slurry acted to suppress the bentonite hydration and retarded the hardening rate of the cement at elevated temperatures. The $CaO\text{-}SiO_2\text{-}H_2O$ (C-S-H) phases formed during curing of the CLCM play essential roles in improving the quality of the hardened CLCMs. It was observed that xonotlite-truscottite transformation resulted in strength reductions and increased water permeability. The plugging ability of fiber glass depends on the conentration and fiber size. The silicate ions dissolved by hot alkaline disintegration of the fiber glass were chemisorbed with Ca^{2+} ions from the cement and led to the precipitation of C-S-H compounds on the fiber surfaces, which improved bond strength at the matrix-fiber interfaces.

33942 (CONF-8509142—, pp 57-62) **Pressure distribution around a well producing at constant pressure in a double-porosity reservoir.** Sageev, A. (Stanford Univ., CA). 1985. NTIS, PC A09/MF A01. File Number DE86004074.

From Geothermal program review; Washington, DC, USA (11 Sep 1985).

This paper presents the characteristics of the pressure response of observation wells during a constant pressure test in a double-porosity bounded system. Wellbore skin in the constant pressure active well is considered negligible. The interacting effects of the exterior radius, r/sub eD/, and the interporosity flow parameter. λ are examined in pressure-radius and pressure-time responses. The pressure-radius semilog responses are semilog straight in the region around the well, indicating a constant rate in space. The shape of the fracture interference pressure response of the observation well is similar to the pressure response during constant rate tests in double-porosity systems. The dimensionless pressure response has a transition period, where, for the pseudo steady state interporosity flow model, the pressure is constant. Interference fracture pressure responses for the pseudo steady state and the transient interporosity flow models are compared. 14 references, 9 figures.

1510 Direct Energy Utilization

REFER ALSO TO CITATION(S) 33938

1520 Geothermal Data And Theory

REFER ALSO TO CITATION(S) 33940

33943 (DOE/SF/15799—T7) **Geothermal research at the Puna Facility.** Chen, B. (Hawaii Univ., Honolulu (USA). Hawaii Natural Energy Inst.). May 1986. Contract FG03-85SF15799. 4p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86007848.

Chemical analyses were conducted on the flocculated silica samples obtained during previous field experiments at HGP-A on both flashed and unflashed brines to determine the composition of the recovered silica for specific constituents of the brine which seem to often be entrapped in the silica during the flocculation process. Metals added as flocculants to the brine were also analyzed in order to evaluate the ease or difficulty with which these

can be removed from the precipitated silica under varying conditions. Conditions employed included simple distilled water and acid washing (HCl of varying concentration).

16 TIDAL AND WAVE POWER

1608 Wave Energy Converters

33944 **Pneumatic wave energy conversion system program developments.** Richards, D.; Weiskopf, F.B.; Ritzovan, P.J. (The Johns Hopkins Univ., Applied Physics Lab., Laurel, MD). pp 8 of Proceedings of the ASME winter annual meeting. New York, NY; American Society of Mechanical Engineers (1984). (CONF-841201—).

From ASME winter annual meeting; New Orleans, LA, USA (9 Dec 1984).

The U.S. Department of Energy (DOE) has supported the development and construction of a Pneumatic Wave Energy Conversion System (PWECS) based on the McCormick counter-rotating turbine. The PWECS was designed as the power take-off device of an oscillating water column (OWC) wave energy convertor in which ocean waves alternately compress and expand the air in a chamber connected to the turbine. The John Hopkins University Applied Physics Laboratory (APL) was requested by the DOE Division of Ocean Energy Technology (DOET) to perform a system analysis and cost study of PWECS genreated power and plan for proposed ocean tests. To support the system analyses and test planning, a numerical model has been developed which couples the hydraodynamics and thermodynamics of the OWC with the dynamics of the PWECS power train. The numerical model has been utilized in parametric studies of a 'terminator' (wave barrier) concept with directional shaped entrance. Model predictions for this design are used to assess power variability issues and projections for cost of delivered power. These developments are discussed as are other program elements.

17 WIND ENERGY

1704 Economics

33945 **(EPRI-AP—4199) Wind power stations: 1984 performance and reliability.** Lynette, R. (Lynette (R.) and Associates, Inc., Bellevue, WA (USA)). Aug 1985. 127p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920805.

The objective of this report is to present the results of an assessment of field experience at a number of wind turbine sites. Operational information was collected and assessed from six commercial wind power stations and four experimental test sites. The data covers eight different wind turbine types and a total of 372 machines. The results are presented for the current experience, and projections are developed for future large wind power stations. Most of the commercial wind power stations assessed had average availabilities above 0.90, and several achieved average availabilities of 0.97 to 0.98. Direct operation and maintenance costs for the commercial stations averaged $0.02 per kWh, with a potential to reduce costs to $0.01 after incorporation of additional product improvements (1984 dollars, not levelized). Additional work is needed to improve wind turbine siting. The large experimental wind turbines with ratings of 2.5 to 4.0 MW had average availabilities below the levels required for commercial service. Although these machines have the potential to achieve satisfactory performance levels, their reliability growth has been slow.

1706 Wind Energy Engineering

33946 **(EPRI-AP—4054) WTS-4 wind turbine test program. Final report.** Hasbrouck, T. (Hamilton Standard, Windsor Locks, CT (USA)). Jun 1985. 219p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920829.

A summary of activity and results for a test project on the WTS-4 wind turbine, sited at Medicine Bow, Wyoming, is provided. The project was jointly funded by the Electric Power Research Institute and Hamilton Standard. The objectives of the project were to: (1) develop an improved understanding of wind turbine technology; (2) evolve wind turbine test methods and capabilities; and (3) help EPRI identify research activities that promote the evolution and use of utility grade wind power stations. The 4-megawatt WTS-4, designed and developed by Hamilton Standard, is owned by the US Bureau of Reclamation. It was erected in the fall of 1982 and by the end of 1983 had generated approximately 1500 megawatt hours. Significant operational events that occurred during the first full year of operation are reviewed.

20 ELECTRIC POWER ENGINEERING

REFER ALSO TO CITATION(S) 34605

33947 **(EPRI-P—4411-SR) 1986 Research and Development Program Plan.** (Electric Power Research Inst., Palo Alto, CA (USA). Planning and Evaluation Div.). Jan 1986. 102p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920282.

EPRI's 1986 Research and Development Program Plan describes the program in terms of six broad research areas (Fuels, Generation, Delivery, Utilization, Environment, and Analysis and Planning) and seventeen strategic programs. The strategic programs provide a more detailed description of the overall research program by delineating EPRI's technical goals, our role in pursuing specific technologies, and the general time frames during which program results are targeted. This document provides a glimpse of the future stream of results from the EPRI program, allowing utilities to anticipate advances that will be beneficial for planning, design, and operation.

2001 Power Plants And Power Generation

REFER ALSO TO CITATION(S) 33548, 33727, 34102, 34283, 34707

33948 **(DOE/MC/21233—2010) Evaluation of alternate combustor concepts for gas turbine applications. Topical report, October 1984-October 1985.** Lew, H.G.; Pillsbury, P.W. (Westinghouse Electric Corp., Concordville, PA (USA). Power Generation Operations Div.). Feb 1986. Contract AC21-84MC21233. 52p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86001085.

A program to determine the feasibility of applying a slagging coal-fired combustor to a gas turbine is reported. This program contains an evaluation of the potential for controlling the products of combustion from this type of combustor burning dry pulverized coal and coal water mixtures. This evaluation includes the design and fabrication of a refractory lined slagging combustor and the performance of combustion tests in the Westinghouse advanced combustor development rig. This Topical Report contains the description of the work preparation necessary to perform the combustion tests. It includes the combustor design, the test facility modifications, the emission instrumentation changes, and the coal fuel characteristics. 2 refs., 15 figs., 8 tabs.

33949 **(DOE/MC/21391—T1) Injection and combustion of coal fuels in gas turbine combustors. Topical report, September 1984-September 1985.** Dodge, L.G.; Moulton, D.S. (Southwest Research Inst., San Antonio, TX (USA)). Oct 1985. Contract AC21-84MC21391. 63p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86004466.

(1) Low-viscosity reasonably stable slurries of coal/water, coal/jet-fuel, and coal/methanol have been formulated, and the first two types have been characterized for rheological properties. (2) A number of different spinning nozzles or cup atomizers have been tested for atomization characteristics on a variety of Newtonian liquids and coal/water slurries. (3) Several delivery systems and nozzles have been constructed and testing has begun for injecting powdered coal into a combustion system. 2 refs., 23 figs., 9 tabs.

33950 **(EPRI-AP—4580) UNIRAM analyses of power system maintenance strategies. Final report.** Young, R.C.; Johnson, W. (Arinc Research Corp., Annapolis, MD (USA)). May 1986. 93p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920300.

The UNIRAM availability assessment software program was developed by ARINC Research Corporation for the Electric Power Research Institute to analyze the availability potential of competing advanced power system designs. UNIRAM is sufficiently flexible to be used in analyzing the availability of existing plants. The availability of a power generation unit is a function of the configuration of the unit and the capacity, reliability, and maintainability of the unit's components. Component maintainability is a function of the component design, its location within the plant, the skills and availability of the maintenance labor, and the spare parts maintained in inventory. This report describes how the UNIRAM methodology was used to evaluate spare parts and maintenance strategies. 32 figs., 23 tabs.

33951 **(EPRI-CS—4321) Wet-dry cooling demonstration. Test results.** Allemann, R.T.; DeBellis, D.E.; Werry, E.V.; Johnson, B.M. (Pacific Northwest Labs., Richland, WA (USA)). May 1986. Contract AC06-76RL01830. 130p. NTIS, PC A07/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303; GPO Dep. File Number DE86011178.

A large-scale test of dry/wet cooling using the ammonia phase-change system, designated the Advanced Concepts Test (ACT), has been operated at Pacific Gas and Electric Company's Kern Station at Bakersfield, California. The facility is capable of condensing 60,000 lbs/h of steam from a small house turbine. Two different modes of combining dry and evaporative cooling have been tested. One uses deluge cooling in which water is allowed to flow over the fins of the dry (air-cooled) heat exchanger on hot days; the other uses a separate evaporative condenser in parallel to the dry heat exchanger. A third mode of enhancing the dry cooling system, termed capacitive cooling has been tested. In this system, the ammonia-cooled steam condenser is supplemented by a parallel conventional water-cooled condenser with water supplied from a closed system. This water is cooled during off-peak hours each night by an ammonia heat pump which rejects heat through the ACT Cooling Tower. If operated over the period of a year, each of the wet/dry systems would use only 25% of the water normally required to reject this heat load in an evaporative cooling tower. The third would consume no water, the evaporative cooling being replaced by the delayed cooling of the closed system water supply.

33952 **(EPRI-CS—4516-Vol.1) Advanced rotor forgings for high-temperature steam turbines. Volume 1. Ingot and forging production. Final report.** Swaminathan, V.P.; Steiner, J.E.; Mitchell, A. (Westinghouse Electric Corp., Orlando, FL (USA). Steam Turbine Generator Div.). May 1986. 186p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920295.

Three advanced steel-melting processes - low-sulfur vacuum silicon deoxidation, electroslag remelting, and vacuum carbon deoxidation (VCD) - were applied to produce three CrMoV (ASTM A470, Class 8) steel forgings for steam turbine application. Ingots weighing about 100 t each were produced using these three processes, and rotors were forged with final weights of about 30 t each. Compared to the conventionally produced forgings, the advanced technology forgings show better tensile ductility and better uniformity along the radial and longitudinal directions. Charpy upper-shelf energy shows about 40% improvement, and no temper embrittlement was found using step-cooled and isothermal-aging treatments. Significant improvement in fracture toughness (K/sub IC/ and J/sub IC/) is realized for these forgings. Low-cycle fatigue life is better at high temperatures because of the absence of nonmetallic inclusions. Creep strength shows slight improvement. However, creep ductility is improved, probably because of low residual elements. The VCD forgings show excellent creep ductility, even with long lives. Both the toughness and creep properties are equal to or better than those of oil-quenched rotors produced by European practices. These improvements are attributed to cleaner steel, better control of ingot solidification, low residual elements (especially very low sulfur content), and the associated reduction of nonmetallic inclusions. These three rotors have been placed in service in three operating power plants in units rated at 520 MW each. Volume 1 of this report covers ingot and forging production, and volume 2 covers mechanical property evaluation.

33963 **(EPRI-CS—4516-Vol.2) Advanced rotor forgings for high-temperature steam turbines. Volume 2. Mechanical property evaluation. Final report.** Swaminathan, V.P.; Landes, J.D. (Westinghouse Electric Corp., Orlando, FL (USA). Power Generation Headquarters). May 1986. 174p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920288.

Three advanced steel-melting processes - low-sulfur vacuum silicon deoxidation, electroslag remelting, and vacuum carbon deoxidation (VCD) - were applied to produce three CrMoV (ASTM A470, Class 8) steel forgings for steam turbine application. Ingots weighing about 100 t each were produced using these three processes, and rotors were forged with final weights of about 30 t each. Compared to the conventionally produced forgings, the advanced technology forgings show better tensile ductility and better uniformity along the radial and longitudinal directions. Charpy upper-shelf energy shows about 40% improvement, and no temper embrittlement was found using step-cooled and isothermal-aging treatments. Significant improvement in fracture toughness (K/sub IC/ and J/sub IC/) is realized for these forgings. Low-cycle fatigue life is better at high temperatures because of the absence of nonmetallic inclusions. Creep strength shows slight improvement. However, creep ductility is improved, probably because of low residual elements. The VCD forgings show excellent creep ductility, even with long lives. Both the toughness and creep properties are equal to or better than those of oil-quenched rotors produced by European practices. These improvements are attributed to cleaner steel, better control of ingot solidification, low residual elements (especially very low sulfur content), and the associated reduction of nonmetallic inclusions. These three rotors have been placed in service in three operating power plants in units rated at 520 MW each. Volume 1 of this report covers ingot and forging production, and volume 2 covers mechanical property evaluation. 40 refs., 84 figs., 15 tabs.

33954 **(EPRI-EL—4567) Large-deviation approximation computation of generating-system reliability and production costs. Final report.** Mazumdar, M. (Pittsburgh Univ., PA (USA). Dept. of Industrial Engineering). May 1986. 76p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920310.

This report describes the result of an investigation on the performance of Esscher's large deviation approximation scheme for the calculation of the LOLP (loss of load probability) index and the unit capacity factors in a production costing context. Results indicate that the large deviation approximation is accurate, speedy and robust enough to be adopted in routine utility practice for the purpose of LOLP estimation. It also represents an accurate computational procedure for determining production costing functions.

2002 Environmental Control Technology

REFER ALSO TO CITATION(S) 33570, 33571, 33572, 33573, 33574, 33575, 33576, 33577, 33578, 33579, 33580, 33581, 33582, 33583, 33584, 33585, 33586, 33587, 33588, 33589, 33590, 33591, 33592, 33595, 33596, 33597, 33598, 33599, 33601, 33603, 33604, 33606, 33607, 33609, 33610, 33611, 33612, 33613, 33614, 33615, 33616, 33617, 33618, 33620, 33623, 34733, 34735, 34799

33955 **(DOE/ET/15492—2030) Laboratory/bench scale testing and evaluation of A.P.T. Dry Plate Scrubber.** Jain, R.C.; Young, S.C. (Air Pollution Technology, Inc., San Diego, CA (USA)). Jul 1985. Contract AC21-80ET15492. 288p. NTIS, PC A13/MF A01; 1; GPO Dep. File Number DE86001075.

The A.P.T. Dry Plate Scrubber (DPS) was developed for the simultaneous removal of particles and alkali vapors from high temperature and high pressure gas streams. The DPS uses a shallow, dense, mobile bed of solid collector granules supported on perforated plates. The gas stream containing fine particles and vapors is moved upward through the perforations to form high velocity

gas jets. Fine particles are removed by inertial deposition on granules. Alkali vapors are removed by sorption on granular sorbents. Bench scale experiments were performed under ambient conditions, on a slip stream of flue gas from an atmospheric fluidized bed combustor,and on simulated high temperature and pressure gas streams to obtain design information and to determine its particle and alkali vapor collection efficiency. Results clearly show that the DPS is capable of removing particles and alkali vapor under high temperature conditions. The DPS particle collection efficiency can be improved by precharging the particles and by polarizing the granules with an electric field. The particle collection efficiency of an electrostatically augmented DPS exceeds 98%, which is enough for cleaning the PFBC gas stream to meet the GE turbine tolerance and EPA NSPS emission regulations. Bench scale alkali vapor collection experiments identified diatomaceous earth and activated bauxite as the two most promising sorbents. At a contact time of 0.2 seconds, these two sorbents can remove 99% of the alkali vapor. A preliminary process design and cost estimate was performed based on the requirements of one PFBC combustor-turbine module. 34 refs., 91 figs., 21 tabs.

33956 **(EPRI-CS—4482-Vol.1) Microcomputer-based flow and mass balances for power plant water management. Volume 1. Guidelines. Final report.** Rosain, R.M.; Ehlert, D.; Card, T.R. (CH2M Hill, Bellevue, WA (USA)). May 1986. 127p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920286.

Decreasing raw water supplies and increasing environmental regulatory constraints and costs are strong motivations for many electric generating stations to make their water management and treatment systems more effective. Proactive industrial water management requires an accurate and efficient system to account for water uses. Water and salt balances that inventory, track, and cross-check the flow of water and its constituents throughout the plant can greatly aid in this effort. A procedure for computerizing these calculations for power plant water and wastewater management systems has been developed using desk-top microcomputers and commercially available, prepackaged software. A computerized flow and mass balance was first developed at the Hayden Generating Station of Colorado Ute Electric Association using a FORTRAN-based program on a mainframe computer. The current program, which expands the original procedure and adapts it to microcomputers and prepackaged software, was demonstrated at the San Juan Generating Station of Public Service Company of New Mexico (PNM). The microcomputer procedure is described in this two-volume document. Volume 1 (this volume) contains step-by-step descriptions and instructions for developing and using a water and salt balance program for an operating water management and treatment system. It also describes suitable microcomputer hardware and software for use in such a model.

33957 **(EPRI-CS—4482-Vol.2) Microcomputer-based flow and mass balances for power plant water management. Volume 2. Case study. Final report.** Rosain, R.M.; Ehlert, D.; Card, T.R. (CH2M Hill, Bellevue, WA (USA)). May 1986. 280p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920299.

Decreasing raw water supplies and increasing environmental regulatory constraints and costs are strong motivations for many electric generating stations to make their water management and treatment systems more effective. Proactive industrial water management requires an accurate and efficient system to account for water uses. Water and salt balances that inventory, track, and cross-check the flow of water and its constituents throughout the plant can greatly aid in this effort. A procedure for computerizing these calculations for power plant water and wastewater management systems has been developed using desk-top microcomputers and commercially available, prepackaged software. A computerized flow and mass balance was first developed at the Hayden Generating Station of Colorado Ute Electric Association using a FORTRAN-based program on a mainframe computer. The current program, which expands the original procedure and adapts it to microcomputers and prepackaged software, was demonstrated at the San Juan Generating Station of Public Service Company of New Mexico (PNM). The microcomputer procedure is described in this two-volume document. Volume 1 contains step-by-step descriptions and instructions for developing and using a water and salt balance program for an operating water management and treatment system. It also describes suitable microcomputer hardware and software for use in such a model. Volume 2 (this volume) reports on the case study performed on the San Juan Station water management system.

33958 **(PB—86-148145/XAB) Calcination of calcium-based sorbents for control of SO_2 emissions from coal fired boilers.** Harrison, D.J.; Newton, G.H.; Pershing, D.W. (Utah Univ., Salt Lake City (USA). Dept. of Chemical Engineering). Jan 1986. 26p. NTIS, PC A03/MF A01.

The paper summarizes the results of an experimental study that focused on the production of high-surface-area materials from various sorbents. (NOTE: Injecting calcium-based sorbents into coal burning utility boilers to control SO_2 emissions is being considered by the EPA as an acid rain control technology because capital equipment requirements are small and the process is entirely dry. Both theoretical calculations and experimental results indicate that SO_2 capture is strongly related to the surface area of the calcined sorbent. Thus, an improved understanding of the formation of surface area is required for the complete optimization of the sorbent injection process.) Weight loss and B.E.T. surface area data were obtained as a function of residence time and furnace temperature for 14 different sorbents which were members of 4 distinct classes: limestones, dolomites, hydrated limes, and pressure hydrated dolomitic limes. The results demonstrate major differences between classes of sorbents. In general, the hydrated limes calcined faster and produced higher surface areas than the corresponding carbonates. The dolomitic materials also produced higher surface areas than the comparable calcitic sorbents. Pressure hydrated dolomitic limes performed the best, producing surface areas in excess of 140 sq m/g; the limestones performed the worst.

33959 **(PB—86-156957/XAB) Study of rapping reentrainment emissions from a pilot-scale electrostatic precipitator.** Bush, P.V. (Southern Research Inst., Birmingham, AL (USA)). 1984. 9p. NTIS, PC A02/MF A01.

The article gives results of a test program to determine the quantity and size distribution of rapping reentrainment emissions from a large pilot-scale electrostatic precipitator (ESP) at TVA's Bull Run steam plant. The ESP current density and specific collection area were varied during the testing. The data were compared to information from full-scale ESPs that had been used to derive generic relationships for rapping reentrainment incorporated in the mathematical model of precipitation. The studies showed that the character of the rapping emissions measured on the pilot ESP differs from the generic rapping used in the ESP model.

33960 **(PB—86-157757/XAB) Emissions of vapor-phase fluorine and ammonia from the Columbia coal-fired power plant.** Bauer, C.F.; Andren, A.W. (New Hampshire Univ., Durham (USA). Dept. of Chemistry). 1985. 8p. NTIS, PC A02/MF A01.

Gaseous fluorine and ammonia emissions from two pulverized-coal power plants were measured over a 6-month period. In one unit, emissions contained a median 1.5 mg/scm (standard cubic meter) NH_3 and 1.9 mg/scm F (86% of available F in coal). For the other unit, lower levels were found: 0.042 mg/scm NH_3 and 0.22 mg/scm F (4.2% of available F in coal). Ammonia varied by more than 10 times in each unit and was enhanced in Unit I by addition of ammonium carbonate to improve precipitator efficiency. Fluorine varied less than 50% in each unit. The difference in F between units was related circumstantially to ash content. Daily variation of F and NH_3 was less than 20%. Neither gas was in sufficient quantity relative to SO_2 to influence net acidity. Levels of F were comparable to those of other combustion sources and the aluminum industry. On a global scale, coal combustion is not a major source of either F or NH_3. Among anthropogenic sources, however, it is a significant contributor and may be important locally. In contrast, NH_3 emissions are negligible.

33961 Portland cement for SO_2 control in coal-fired power plants. Steinberg, M. (to The United States of America as represented by the United States Department of Energy). US Patent 4,555,392. 26 Nov 1985. Filed date 17 Oct 1984. vp.

PAT-APPL-661842.

There is described a method of removing oxides of sulfur from the emissions of fossil fuel combustion by injecting portland cement into the boiler with the fuel, the combustion air, or downstream with the combustion gases. There is also described the cement products that result from this method.

2003 Power Transmission And Distribution

33962 (EPRI-EL—4501) Electrification problems resulting from liquid dielectric flow. Final report. Gasworth, S.M.; Melcher, J.R.; Zahn, M. (Massachusetts Inst. of Tech., Cambridge (USA). High Voltage Research Lab.). Apr 1986. 138p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920285.

The use of new fluids and new operating systems has led to electrification problems in HVDC substations. In this study, researchers developed a model of flow-induced electric fields in insulating structures, created techniques for monitoring electrification effects, and designed a charge trap that decreases these effects.

33963 (EPRI-EL—4540-CCM-Vol.12) TLWorkstation code, Version 1.0. Volume 12. BRODIFLX manual. Computer code manual. LeMaster, R.A. (Sverdrup Technology, Inc., Tullahoma, TN (USA)). May 1986. 49p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920306.

The BRODI2 and BROFLX programs are used to compute the longitudinal unbalanced loads acting on transmission line structures due to unequal wind or ice distribution on the conductors or shield wires. Broken conductors may also be considered. The BORFLX program is used to generate the flexibility matrices of the structures in a segment of the line. The flexibility matrices along with conductor, line profile, and loading information are used by BRODI2 to compute the conductor and ground wire attachment point loads. The solution program is documented in EPRI report EL-1560-ccm, July 1982. In the TLWorkstation version of BRODI2 and BROFLX, the programs have been combined into a single program called BRODIFLX. The BRODIFLX progam contains all the analysis features offered by the original programs; however, it also provides a user-friendly-interactive-graphics pre-processor designed to facilitate the use of the program in a workstation type environment. This is Volume 12 of an 18-volume report.

33964 (EPRI-EL—4540-CCM-Vol.13) TLWorkstation code, Version 1.0. Volume 13. ETAP manual. Computer code manual. LeMaster, R.A. (Sverdrup Technology, Inc., Tullahoma, TN (USA)). May 1986. 68p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920307.

ETAP is being developed in conjunction with full-scale tower tests at EPRI's Transmission Line Mechanical Research Facility (TLMRF). Experimental data obtained from tests conducted at the TLMRF are compared to analytical results obtained from ETAP. As differences between the analyses results and test data are identified, parametric analyses are performed to aid in identifying the source of the differences. In most cases, additional test data is also required. As a better understandig of the tower behavior is obtained, ETAP is updated to reflect this understanding, thus providing an improved analysis tool. The present version of the ETAP program is a displacement-based finite-element computer program for the static analysis of overhead electric transmission structures. It contains truss, beam, cable, and tension-only elements which can be used to stimulate the behavior of lattice, pole, H-frame, and guyed transmission line structures. ETAP may be used as a stand-alone program, or in conjunction with EPRI Tower Analysis Generator (TAG) program. This is Voluem 13 of an 18-volume report.

33965 (EPRI-EL—4540-CCM-Vol.14) TLWorkstation code, Version 1.0. Volume 14. POLEDA-80 manual. Computer code manual. LeMaster, R.A. (Sverdrup Technology, Inc., Tullahoma, TN (USA)). May 1986. 55p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920308.

The POLEDA-80 program analyzes transversely loaded, single-pole, unguyed transmission structures subject to wind, ice, and dead load. The analysis mode of the program provides a tool for use in the analysis of existing structures, and the design mode is for use in the design of proposed structures. The solution program for POLEDA-80 is documened in EPRI report EL-2049, Volumes 1, 2, 3, 1981. The TLWorkstation version of POLEDA-80 contains a user-friendly-interactive-graphics pre- and post-processor designed to facilitate the application of the program in an interactive environment. The pre-processor employs a fill-in-the-blank input mode, which enables each data item to be changed at any point during the interactive work session. The program provides a data base containing the American National Standard wood pole geometric properties to reduce the amount of user generated input data. This is volume 14 of an 18-volume report.

33966 (EPRI-EL—4540-CCM-Vol.15) TLWorkstation code, Version 1.0. Volume 15. TAG manual. Computer code manual. LeMaster, R.A. (Sverdrup Technology, Inc., Tullahoma, TN (USA)). May 1986. 96p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920309.

The TAG program is specifically written for the purpose of modeling three-dimensional truss and frame structures as used in transmission line construction. TAG consists of pre- and post-processors that are highly interactive and user-friendly, capable of taking full advantage of the various analysis techniques available in the ETAP program. The TAG pre-procesor employs state-of-the-art modeling techniques and graphic display to quickly develop complex structures. Once the user is satisfied with a model, an ETAP compatible solution file is generated. After running ETAP, the TAG post-processor is used to efficiently evaluate results in terms of deflected shape plots, stress summaries, and additional load combinations. This is Volume 15 of an 18-volume report.

33967 (ORNL/TM—9724) Powerline frequency measurement. Rochelle, R.B.; Rochelle, R.W.; Adams, R.K. (Oak Ridge National Lab., TN (USA)). May 1986. Contract AC05-84OR21400. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86011344.

A microcomputer has been used to measure powerline frequency with a precision of six decimal digits (0.0001 Hz) using an averaging time of 3 to 4 min. The algorithm for frequency measurement requires no multiplication or division operations, so a very simple microprocessor can be used. The frequency measurement is sensitive enough to permit detection of small, controlled changes in generation, hence in powerline frequency. Thus, the results of the frequency measurement can be applied to the load-management field. Methods based on these principles have the potential of providing an inexpensive communications path between the power supplier and the industrial user for purposes of shedding load during peak power usage.

33968 (PB—86-156841/XAB) Electric-transmission-line costs and construction lead times. Working paper. (Office of Technology Assessment (U.S. Congress), Washington, DC). Nov 1984. 42p. NTIS, PC A03/MF A01.

The study was commissioned by the Office of Technology Assessment to determine the potential for constructing new electric-transmission facilities as one strategic response to a long-term major oil-supply disruption. The primary considerations for implementing such a strategy are the time required to build new facilities (including licensing and construction phases) and the cost construction. In performing the work, a number of newly completed and proposed transmission lines were surveyed.

33969 Operational test results of a prototype superconducting power transmission system and their extrapolation to the performance of a large system. Forsyth, E.B.; Thomas, R.A. (Brookhaven National Lab., Associated Universities Inc., Upton, NY 11973). *IEEE Transactions on Power Delivery;* **1**: No. 1, vp(Jan 1986).

Superconducting cables have electrical characteristics which are similar to overhead lines in many ways. They will be suitable for long-distance circuits of relatively high power and are not similar or competitive with conventional underground cables and their usual applications. The testing of a prototype superconducting power transmission system has progressed to those of an operational nature such as unattended life tests, emergency ratings and simulated failure of the cooling system. The results are used to calculate the performance of a transmission system comprising 2 circuits in a route 100 miles long with a 1000 MVA rating. In addition the measured performance is compared with systems studies made during the development phase.

33970 Particle trap for compressed gas insulated transmission systems. Cookson, A.H. (to Dept. of Energy, Washington, DC). US Patent 4,554,399. 19 Nov 1985. Filed date 26 Apr 1984. vp.

PAT-APPL-604352.

A particle trap is provided for gas insulated transmission lines having a central high voltage conductor supported within an outer coaxial conductive sheath by a dielectric support member. A cavity between the inner conductor and outer sheath is filled with a dielectric insulating gas. A cone-like particle deflector, mounted to the inner conductor, deflects moving particles away from the support member, to radially outer portions of the cavity. A conductive shield is disposed adjacent the outer sheath to form a field-free region in radially outer portions of the cavity, between the shield and the sheath. Particles traveling along the cavity are deflected by the cone-like deflector into the field-free region where they are held immobile. In a vertical embodiment, particles enter the field-free region through an upper end of a gap formed between shield and sheath members. In a horizontal embodiment, the deflector cone has a base which is terminated radially internally of the shield. Apertures in the shield located adjacent the deflector allow passage of deflected particles into the field-free region. The dielectric support member is thereby protected from contaminating particles that may otherwise come to rest thereon.

33971 Effect of an electric field on electron attachment to SF_6 in non-polar liquids. Bakale, G.; Schmidt, W.F. (Case Western Reserve Univ., Cleveland, OH). *Journal of Electrostatics;* **12**: 103-106(1982). Contract AC02-78EV04746.

Sulfur hexafluoride is widely used as a gaseous insulator in high-voltage equipment which is primarily attributable to the electronegative nature of the SF_6 molecule. Due to this property, electrons readily attach to SF_6 and potential electron avalanches are thereby quenched. Several reports have been published in which the effect of SF_6 on the insulating behavior of transformer oil was investigated and where SF_6 was found to influence breakdown at different stages of the discharge. For example, SF_6 dissolved in oil can diffuse into the region of the developing discharge and quench further development of a gaseous discharge channel. Also, in the pre-breakdown stage SF_6 can attach electrons and thus inhibit the electrons from gaining sufficient energy from the electric field to initiate a discharge. In view of the finding that the electron attachment rate constant, k/sub a/, becomes field-dependent in liquid Ar and Xe at fields where u/sub e/ is field-dependent, it was of obvious interest to determine if the same phenomena occurred in liquid hydrocarbons. Therefore, the effect of the electric field, F, on k/sub a/, at F = 50-200 kV/cm in the two liquids in which detailed field-dependent studies of u/sub e/, viz ethane and propane had been made was studied.

21 NUCLEAR POWER PLANTS

REFER ALSO TO CITATION(S) 33783

33972 (AIF/NESP—033) Occupational radiation exposure implications of NRC-initiated multi-plant actions. Cohen, S.C.; Goldin, D.J.; Goldin, A.S. (SC and A, Inc., McLean, VA (USA)). Mar 1986. 115p. Atomic Industrial Forum, Inc., 7101 Wisconsin Ave., Bethesda, MD 20814-4891. File Number TI86901158.

The purpose of this study is to estimate the collective occupational radiation exposure at US nuclear power plants which is attributable to new Nuclear Regulatory Commission (NRC) requirements and changes in existing requirements, and to identify the specific regulatory requirements which contribute most significantly to this exposure. In order to obtain a statistically meaningful estimate and to observe trends, the study is based on five years of data, collected at 10 representative nuclear power stations, containing a total of 16 operating units. The time period 1979 through 1983 was selected because it encompasses the years during which most of the plant modifications resulting from the Three Mile Island (TMI) Action Plan were made. The results indicate that over the five-year period 1979 through 1983, 40% of the total occupational radiation exposure at light water reactors (LWRs) was attributable to NRC-initiated multi-plant actions. Based on the doses of record for LWRs, this percentage represents approximately 99,000 person-rem of collective exposure. The exposures attributable to NRC-initiated MPAs at pressurized water reactors (PWRs) and boiling water reactors (BWRs) over the five-year period were roughly comparable: 38% (more than 47,000 person-rem) at PWRs and 42% (more than 51,000 person-rem) at BWRs.

2101 Power Reactors, Non-breeding, Light-water Moderated, Boiling Water Cooled

REFER ALSO TO CITATION(S) 33977, 33983, 34035, 34050, 34054, 34055, 34057, 34060, 34074, 34093, 34095

33973 (DOE/NE—0067) Modularization and nuclear power. Report by the Technology Transfer Modularization Task Team. (USDOE Assistant Secretary for Nuclear Energy, Washington, DC). Jun 1985. 70p. NTIS, PC A04/MF A01; GPO Dep. File Number DE86011393.

This report describes the results of the work performed by the Technology Transfer Task Team on Modularization. This work was performed as part of the Technology Transfer work being performed under Department of Energy Contract 54-7WM-335406, between December, 1984 and February, 1985. The purpose of this task team effort was to briefly survey the current use of modularization in the nuclear and non-nuclear industries and to assess and evaluate the techniques available for potential application to nuclear power. A key conclusion of the evaluation was that there was a need for a study to establish guidelines for the future development of Light Water Reactor, High Temperature Gas Reactor and Liquid Metal Reactor plants. The guidelines should identify how modularization can improve construction, maintenance, life extension and decommissioning.

33974 (GKN—84) Dodewaard nuclear power plants in 1984. (Gemeenschappelijke Kernenergiecentrale Nederland N.V., Arnhem). 1984. 24p. (In Dutch). NTIS (US Sales Only), PC A02/MF A01. File Number DE86702182.

This report gives an overview of the Dodewaard power reactor's operation, waste processing and radiation protection during the years 1975-1984. The main operation specifications are cast in a table. Special aspects with respect to operation and maintenance are dealt with, viz. repairs to the engine transformator; to the generator; to the fuel transfer pond; and to the hydrogen recombination system. Research programs are briefly outlined.

33975 **(SAND—86-1089C) Construction and analysis of a 1/6th-scale concrete containment model.** Horschel, D.S.; Jung, J. (Sandia National Labs., Albuquerque, NM (USA)). May 1986. Contract AC04-76DP00789. 23p. (CONF-860507—5). NTIS, PC A02/MF A01 - GPO. File Number TI86010958.

From 3. workshop on integrity of containments for nuclear power plants; Washington, DC, USA (21 May 1986).

This paper discusses the features and preliminary analysis of a 1/6th-scale reinforced concrete containment model, which is being constructed at Sandia National Laboratories (SNL) in Albuquerque, New Mexico. The model LWR containment building was designed and is being built to the ASME code by United Engineers and Constructors Inc. The containment model will be tested to failure to determine its behavior to static overpressurization. The results from testing the heavily instrumented containment will be used to assess the capability of analytical methods. 16 figs.

33976 **High-speed LWR transients simulation for optimizing emergency response.** Wulff, W.; Cheng, H.S.; Lekach, S.V.; Mallen, A.N.; Stritar, A. (Brookhaven National Lab., Upton, NY). pp 137-147 of Proceedings of the international conference on power plant simulation. Fernandez-del-Busto, R.; Hetrick, D.L.; Mendez, E. (eds.). Cuernavaca, Mexico; Instituto de Investigaciones Electricas (1984). (CONF-841115—).

From International conference on power plant simulation; Mexico City, Mexico (19 Nov 1984).

The purpose of computer-assisted emergency response in nuclear power plants, and the requirements for achieving such a response, are presented. An important requirement is the attainment of realistic high-speed plant simulations at the reactor site. Currently pursued development programs for plant simulations are reviewed. Five modeling principles are established and a criterion is presented for selecting numerical procedures and efficient computer hardware to achieve high-speed simulations. A newly developed technology for high-speed power plant simulation is described and results are presented. It is shown that simulation speeds ten times greater than real-time process-speeds are possible, and that plant instrumentation can be made part of the computational loop in a small, on-site minicomputer. Additional technical issues are presented which must still be resolved before the newly developed technology can be implemented in a nuclear power plant.

2102 Power Reactors, Non-breeding, Light-water Moderated, Non-boiling Water Cooled

REFER ALSO TO CITATION(S) 33973, 33975, 34034, 34036, 34037, 34043, 34050, 34053, 34054, 34055, 34057, 34060, 34061, 34062, 34063, 34066, 34067, 34069, 34070, 34071, 34074, 34083, 34085, 34086, 34087, 34088, 34089, 34090, 34091, 34092, 34093, 34094, 34095, 34096, 34099, 34289, 34390, 34815

33977 **(BMI—1985-093) Requirements for the training simulator of the new nuclear power plants of the convoi/preconvoi type. Final report.** Simon; Buettner; Vallana; Reppmann; Emmerich. (Bundesministerium des Innern, Bonn (Germany, F.R.); Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Dec 1985. 197p. (In German). (GRS-A—1072). NTIS (US Sales Only), PC A09/MF A01. File Number DE86752040.

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

The requirements have been investigated with regard to the training aspect only and therefore no proposals concerning the technical realisation are given. Within these investigations aspects of simulator training, simulator hardware and software, and plant simulation have been considered. The experiences gathered up to now with simulators are included and already existing studies on this area have been evaluated. (orig./HP).

33978 **(CNEN-DR-GTT—03/85) Improvement of the bubble rise velocity model in the pressurizer using ALMOD 3 computer code to calculate evaporation.** Madeira, A.A. (Comissao Nacional de Energia Nuclear de Brasil, Rio de Janeiro. Dept. de Reatores). 1985. 37p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. File Number DE86702183.

An improvement is studied for the calculation of bubble rise velocity, by adding two different ways to estimate this velocity, one of which is more adequate to pressures normally found in the reactor cooling system. Additionally, a limitation in bubble rise velocity growth was imposed, to account for the actual behavior of bubble rise in two-phase mixtures.

33979 **(CNEN-DR-GTT—04/85) Discharge models through the pressurizer valves. Use of ALMOD computer code.** Madeira, A.A. (Comissao Nacional de Energia Nuclear de Brasil, Rio de Janeiro. Dept. de Reatores). 1985. 42p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. File Number DE86702184.

A reliable estimate of discharge through the pressurizer relief and safety valves is of concern to adequately predict the behaviour of RCS pressure during transients. The discharge models used by the ALMOD code are investigated, as well as ways to implement alternative models from the available literature, which are recommended for different conditions of flow that shall exist during transients requiring discharge through the relief and safety valves.

33980 **(CNEN-DR-GTT—05/85) Fourth and last part in the modelling implementation project of two asymmetric cooling systems for ALMOD 3 computer codes.** Dominguez, L.; Camargo, C.T.M. (Comissao Nacional de Energia Nuclear de Brasil, Rio de Janeiro. Dept. de Reatores). 1985. 46p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. File Number DE86702185.

A two loop simulation capability was developed to the ALMOD 3W2 code through modelling the steam header line connecting the secondary side of steam generators. A brief description of the model is presented and two test cases are shown. Basic code changes are addressed.

33981 **(EGG-RTH—7171) INEL design studies in support of the Westinghouse EPRI small plant study.** Burtt, J.D.; Kullberg, C.M. (EG and G Idaho, Inc., Idaho Falls (USA)). Mar 1986. Contract AC07-76ID01570. 75p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86011053.

In support of the design effort of a Westinghouse EPRI small plant study, several analyses were performed at the Idaho National Engineering Laboratory. An analysis was performed to study fuel behavior under conditions of a limiting flow coastdown transient. Depressurization capabilities for the reactor coolant system were studied. The post-accident heat removal for the current containment design was studied. The results of all three studies are reported. 31 figs.

33982 **(EGG-TMI—7174) TMI-2 source and intermediate range neutron flux monitors data report.** McCormick, R.D. (EG and G Idaho, Inc., Idaho Falls (USA)). Mar 1986. Contract AC07-76ID01570. 26p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011030.

This is a report on the preparation of data from the TMI-2 excore source and intermediate range neutron flux monitors for inclusion into the TMI Data Base. The sources of the as-recorded data are discussed as well as the process of transforming these data into digital form. The corrections to the as-recorded data are given and the data quality classification and uncertainty are established. The identifiers attached to each data set in the TMI Data Base are given.

33983 **(EPRI-NP—4315-SR) Nondestructive Evaluation Program. Progress in 1985.** Dau, G.J.; Behravesh, M.M.; Liu, S.N.; Oldberg, T.; Avioli, M.J. Jr.; Scheibel, J.R.; Sharma, D.; Norris, D.M.; Tagart, S.W. Jr.; Griesbach, T.J. (Electric Power Research Inst., Palo Alto, CA (USA)). May 1986. 372p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920291.

The increasing cost of equipment for power generating plants and the potential increases in productivity and safety available through rapidly developing Nondestructive Evaluation (NDE) technology led EPRI to initiate a Nondestructive Evaluation Program in 1974. To date, the major focus has been on light water reactor inspection problems; however, increased application to other

systems is now under way. This report presents a comprehensive review of the EPRI effort in the NDE area. Most of the report consists of contractor-supplied progress on each current project. An organizational plan of the program is presented in overview. In addition, organization from several viewpoint is presented, e.g., in-service inspection operators, R and D personnel, and utility representatives. As the seventh in a planned series of annual progress reports on EPRI-funded NDE activities, this report also serves as the proceedings of the EPRI Joint NDE/Structural Mechanics information meeting held in Palo Alto, California, on November 20-21, 1986. It summarizes progress made since the previous EPRI Special Report NP-3821-SR was issued in May 1985. Section 1 contains information about the program organization, and the sections that follow contains contractor-supplied progress reports of each current project. The progress reports are grouped by plant components - pipe, pressure vessel, steam generator and boiler tubes, and turbine. In addition, Part 6 is devoted to discussions of technology transfer.

33984 **(EPRI-NP—4559) Flow-induced vibration of steam generator tubes. Final report.** Axisa, F.; Villard, B.; Sundheimer, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service des Etudes Mecaniques et Thermiques; Framatome, 92 - Paris La Defense (France)). May 1986. 510p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920284.

Includes 6 sheets of 24x reduction microfiche.

This report presents results concerning flow-induced vibration in a square pitch tube bundle successively subjected to air-water flow of density ranging from 40 to 400 kg m^{-3}. The most prominent vibration excitation mechanism observed was fluidelastic instability. Air-water and steam-water critical flow velocities are adequately predicted using the classical Connors' proportionality factor of 7. Turbulent excitation of the tube bundle was also investigated. 156 figs., 39 tabs.

33985 **(EPRI-NP—4583) Effect of coolant chemistry on PWR radiation transport processes. Progress report on reactor loop studies.** Brown, D.J.; Flynn, G.; Haynes, J.W.; Kitt, G.P.; Large, N.R.; Lawson, D.; Mead, A.P.; Nichols, J.L.; Woodwark, D.R. (UKAEA Atomic Energy Research Establishment, Harwell). May 1986. 42p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920287.

The effect of various PWR-type coolant chemistry regimes on the behavior of corrosion products has been studied in the DIDO Water Loop at Harwell. There are strong indications that the in-core deposition behavior of corrosion product species is not fully accounted for by the solubility model based on nickel ferrite; boric acid plays a role apart from its influence on pH, and corrosion products are adsorbed to some extent in the zirconium oxide film on the fuel cladding. In DWL, soluble species appear to be dominant in deposition processes. A most important factor governing deposition behavior is surface condition; the influence of weld regions and the effect of varying pretreatment conditions have both been demonstrated. 13 figs.

33986 **(EPRI-NP—4597) Chemical cleaning of Millstone Unit 2. Final report.** Pearl, W.L. (NWT Corp., San Jose, CA (USA)). May 1986. 115p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303. File Number TI86920296.

An evaluation of the initial PWR plant application for the chemical cleaning of the sludge pile on the tubesheet of the Millstone Unit 2 steam generators is reported. The planning process is reviewed including: the early planning and process selection, qualification and application and the advanced planning of the system design, subsystem layouts, corrosion monitoring, waste disposal, ALARA concerns and contingencies. The site activities are discussed relative to the chemical cleaning and decisions made during the chemical cleaning. The results of the chemical cleaning are discussed including the effectiveness of the sludge removal, corrosion results, chemical waste, manpower considerations and problems encountered. A comparison is made between the process used at Millstone 2 and the SGOG generic process. Recommendations for future chemical cleaning activities are formulated based on the Millstone experience. 12 refs., 21 figs., 19 tabs.

33987 **(EPRI-NP—4600) Effect of venting on crevice cleaning for PWR steam generators. Final report.** Parke, J.M.; Schneidmiller, D.; Olson, P.M. (Pacific Nuclear Services, Richland, WA (USA)). May 1986. 106p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920297.

Process parameters affecting chemical cleaning of tube-to-support plate crevice annuli in dented PWR steam generators were investigated. A simple procedural modification to the generic SGOG crevice cleaning process was identified which assures that support plate crevices can be consistently cleaned within reasonable guidelines for solvent contact time (under test conditions). The key parameter affecting crevice cleaning rates was identified as strong solvent agitation due to near-surface boiling during system venting. For actual application, the solvent level in the steam generator must be adjusted to be just above the support plate to be cleaned and the steam generator vented periodically to reduce pressure to induce near-surface boiling in the solvent. 13 figs., 12 tabs.

33988 **(GEND—071) TMI criticality studies: lower vessel rubble and analytical benchmarking.** Westfall, R.M.; Knight, J.R.; Fox, P.B.; Hermann, O.W.; Turner, J.C. (Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA)). May 1986. Contract AC07-76ID01570. 48p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86011013.

A bounding strategy has been adopted for assuring subcriticality during all TMI-2 defueling operations. The strategy is based upon establishing a safe soluble boron level for the entire reactor core in an optimum reactivity configuration. This paper presents the determination of a fuel rubble model which yields a maximum infinite lattice multiplication factor and the subsequent application of cell-averaged constants in finite system analyses. Included in the analyses are the effects of fuel burnup determined from a simplified power history of the reactor. A discussion of the analytical methods employed and the determination of an analytical bias with benchmark critical experiments completes the presentation. 14 refs., 17 tabs.

33989 (INIS-mf—10109, pp 4-1 - 4-8) **Effect of research results on rationalization of V-1 nuclear plant operation and prospects to coming period.** Polak, V.; Vytiska, M. (Vyskumny Ustav Jadrovych Elektrarni, Jaslovske Bohunice, Czechoslovakia). 1984. (In Slovak). NTIS (US Sales Only), PC A11/MF A01. File Number DE86702065. (CONF-8411248—Pt.1).

From Conference on economics, operating reliability and safety of WWER-440 type nuclear power plants; Tatranska Lomnica, Czechoslovakia (20 Nov 1984).

The implemented results are listed of research conducted by VUJE, most important are a combined sensor of temperature gradient and an equipment for accurate measurement of the supply mains frequency. Also applied were the results of investigations of steady state and non-steady state regimes of the V-1 nuclear power plant, of in-service testing, of the system of personnel training, of devices for reducing the volume of solid radioactive wastes, etc. Implementation of the research results in the operation of the nuclear power plant has helped increase the supply of electric power to the grid and has increased safety and reliability of power plant operation. Other areas of research are presented whose results will be implemented in 1985 and 1986.

33990 (INIS-mf—10109, pp 16-1 - 16-3) **Increasing operating efficiency.** Palay, I.; Pokojny, G. (Atomova Elektraren Bohunice, Jaslovske Bohunice, Czechoslovakia). 1984. (In Slovak). NTIS (US Sales Only), PC A11/MF A01. File Number DE86702065. (CONF-8411248—Pt.1).

From Conference on economics, operating reliability and safety of WWER-440 type nuclear power plants; Tatranska Lomnica, Czechoslovakia (20 Nov 1984).

Specific measures are presented which are used for increasing the efficiency of the V-1 nuclear power plant. Devices for continuous cleaning have been mounted on all main turbogenerator condensers; this increased and stabilized electric output. Efficiency and output were then increased by more accurate measurement of DELTAtsub(RE) and by controlling the heat output of the reactor

for the f>=49 Hz frequency by replacing unsuitable high pressure regeneration heaters by stainless steel heaters and by cutting the own consumption of the unit.

33991 **(KFKI—1986-11/G) Studies to the Stochastic theory of the coupled Reactorkinetic-Thermohydraulic Systems. Part VI. Analysis of low-frequency noise phenomena.** Kozma, R.; Katona, T. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). 1986. 23p. (CONF-860414—10). NTIS (US Sales Only), PC A02/MF A01. File Number DE86901414.

From 6. power plant dynamics, control and testing symposium; Knoxville, TN, USA (14 Apr 1986).

In the paper a one-dimensional space-dependent coupled neutron-thermohydraulic reactor noise model is applied to the investigation of PWR cores. Calculations show several interesting features of the Auto and Cross Power Spectral Density functions such as space-dependence and the appearance of peaks in the neutron CPSDs at low-frequency, sink structure, etc. It is demonstrated that our model helps to answer the question whether several main parameters of the core (the coolant flow velocity, the heat transfer coefficient from the fuel to the coolant) can be determined on the basis of measured characteristics. 15 refs., 12 figs.

33992 **(NUREG—1191) Technical Specifications, Catawba Nuclear Station, Unit Nos. 1 and 2 (Docket Nos. 50-413 and 50-414). Appendix "A" to License Nos. NPF-35 and NPF-52.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). May 1986. 565p. NTIS, PC A24/MF A01 - GPO. File Number TI86901440.

These specifications cover: definitions, safety limits and limiting safety system settings, bases, limiting conditions for operation and surveillance requirements, design features, and administrative controls. (JDB)

33993 **(NUREG/CR—4584) Reduced pressure and fluid to fluid scaling laws for two-phase flow loop.** Kocamustafaogullari, G.; Ishii, M. (Argonne National Lab., IL (USA)). Apr 1986. Contract W-31-109-ENG-38. 45p. (ANL—86-19). NTIS, PC A03/MF A01 - GPO. File Number TI86010923.

Scaling criteria for a natural circulation loop under single-phase and two-phase to two-phase flow conditions are derived. The criteria include the effects of primary fluid properties so one can use for modeling a high-pressure water system by a low-pressure water system or by a different fluid system. In addition to the standard single-phase flow dimensionless groups, it is shown that the phase change, subcooling, drift-flux and Froude numbers are particularly important for a two-phase flow simulation. Based on the results obtained from the rigorous similarity analysis, practical applications for designing a scaled-down model are considered. Special emphasis is given on scaling at reduced pressure levels relative to a prototype system and fluid to fluid scaling. It is a challenging problem to design a scaled-down model with different fluid properties due to a large number of similarity groups to be matched between a model and a prototype. The present study demonstrates a new approach to this classical problem using the two-phase flow scaling criteria. It indicates that a real time scaling is not a practical solution, and a scaled-down model should have an accelerated (shortened) time scale. One of the most important tesults is the new scaling methodology for simulating pressure transients. It is obtained by considering the changes of the fluid property groups which appear within the two-phase similarity parameters and the single-phase to two-phase flow transition parameters. 11 refs., 11 figs.

33994 **Heavy-Section Steel Technology pressurized-thermal-shock experiment, PTSE-1.** Bryan, R.H.; Bass, B.R.; Merkle, J.G.; Pugh, C.E.; Robinson, G.C.; Whitman, G.D. (Oak Ridge National Lab., TN, USA). *Engineering Fracture Mechanics;* **23**: No. 1, 81-97(1986). Contract AC05-84OR21400.

A pressurized-thermal-shock (PTS) facility was developed in the Heavy-Section Steel Technology Program at Oak Ridge National Laboratory for performing experiments that challenge predictions of analytical methods applicable to full-scale reactor pressure vessels under combined loading. The first experiment (PTSE-1) was designed to address three principal issues; (1) warm-prestressing phenomena; (2) crack propagation from brittle to ductile regions; and (3) transient crack stabilization in ductile regions. The paper presents a description of the PTS facility at ORNL and a review of the objectives and results of the first test. Also included are elastodynamic finite-element analyses of the two crack run-arrest events that occurred in the second and third phases of the test. Finally, some conclusions and recommendations are presented based on the outcome of the first experiment.

33995 **Correlations between calculated surveillance dosimeter activities and pressure vessel fluxes in the Arkansas Nuclear One Unit 1 reactor.** Maerker, R.E.; Broadhead, B.L. (Oak Ridge National Lab., TN). *Transactions of the American Nuclear Society;* **50**: 436-438(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

An illustration of the magnitudes of the cross-correlations between cavity dosimetry and fluxes at an important location in the pressure vessel is given for the case of the Arkansas Nuclear One Unit 1 reactor and provides a correspondence with previously reported flux covariance reduction factors. These correlations are seen to extend over energy regions far wider than would be intuitively expected because of the highly correlated nature of the calculated pressure vessel fluxes themselves, thus enhancing the range of pressure vessel flux information that is provided by the dosimetry. Finally, the high degree of correlation between the cavity dosimeters and pressure vessel fluxes shows that ex-vessel dosimetry can be successfully applied to reactor pressure vessel damage surveillance programs.

33996 **Shielding calculation techniques used in the design of fuel storage systems.** Wang, S.S.; Massey, J.V. (NUTECH Engineers, San Jose, CA). *Transactions of the American Nuclear Society;* **50**: 447-448(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

To augment the existing at-reactor fuel storage capacity, many utilities are implementing modular dry storage systems. This paper addresses the shielding design and analysis of one such storage system. Particular attention will be given to comparing various computer and hand calculation techniques. The Nutech horizontal modular storage (NUHOMS) system consists of a dry canister (a stainless steel canister containing seven pressurized water reactor fuel assemblies), a horizontal storage module (a concrete storage module), an on-site transfer cask, a trailer and cask skid, and a hydraulic ram. The shielding analyses utilized hand calculations of direct and scattered radiation, the QADMOD (three-dimensional point kernal computer program and the ANISN (one-dimensional) and DOT-IV (two-dimensional) transport theory computer programs. Each calculational technique has its advantages and disadvantages.

33997 **Phased usage of training simulator for nuclear power plant.** Fraley, D.W.; Scharold, P.G. (UNC Nuclear Industries, Richland, WA). pp 259-263 of Proceedings of the international conference on power plant simulation. Fernandez-del-Busto, R.; Hetrick, D.L.; Mendez, E. (eds.). Cuernavaca, Mexico; Instituto de Investigaciones Electricas (1984). (CONF-841115—).

From International conference on power plant simulation; Mexico City, Mexico (19 Nov 1984).

A full-scope simulator for the Hanford N Reactors is being developed. The Hanford N Reactor is a 4000MW (thermal), graphite-moderated, pressurized water reactor. The N Reactor Operator Training Simulator is a facility used to train and evaluate personnel in safe, efficient operation and maintenance of N Reactor. The Simulator Development Program is different from other integrated hardware and software development efforts. The program has been divided into phases to make the Simulator available for training with partial capability while the development continues. As such, training requirements play a significant role in defining interim product releases and establishing internal schedules. In addition to

assessing the impacts of providing interim training, it is important to estimate the merits of having this capability. The benefits of a nuclear plant simulator are described.

33998 **Thermocouple modeling.** Fryer, M.O. (EG & G Idaho, Inc., Idaho Falls). pp 297-303 of Proceedings of the international conference on power plant simulation. Fernandez-del-Busto, R.; Hetrick, D.L.; Mendez, E. (eds.). Cuernavaca, Mexico; Instituto de Investigaciones Electricas (1984). (CONF-841115—).

From International conference on power plant simulation; Mexico City, Mexico (19 Nov 1984).

The temperature measurements provided by thermocouples (TCs) are important for the operation of pressurized water reactors. During severe inadequate core cooling incidents, extreme temperatures may cause type K thermocouples (TCs) used for core exit temperature monitoring to perform poorly. A model of TC electrical behavior has been developed to determine how TCs react under extreme temperatures. The model predicts the voltage output of the TC and its impedance. A series of experiments were conducted on a length of type K thermocouple to validate the model. Impedance was measured at several temperatures between 22°C and 1100°C and at frequencies between DC and 10 MHz. The model was able to accurately predict impedance over this wide range of conditions. The average percentage difference between experimental data and the model was less than 6.5%. Experimental accuracy was +- 2.5%. There is a striking difference between impedance versus frequency plots at 300°C and at higher temperatures. This may be useful in validating TC data during accident conditions.

2103 Power Reactors, Non-breeding, Graphite Moderated

REFER ALSO TO CITATION(S) 33973, 34028, 34059

33999 **(Juel-Conf—52) Contributions for the seventeenth biennial conference on carbon. Papers.** Delle, W. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.)). Jun 1985. 24p. (CONF-8506108—Exc.). NTIS (US Sales Only), PC A02/MF A01. File Number DE86752042.

From 17. biennial conference on carbon; Lexington, KY, USA (16 Jun 1985).

This report is the compilation of the papers prepared by KFA Juelich GmbH for the 17th Biennial Conference on Carbon. In the contributions, results are presented which were obtained from the application of carbon in the High Temperature Gas-Cooled Reactor and for the Spallation Neutron Source planned in the Federal Republic of Germany. (orig.).

2104 Power Reactors, Non-breeding, Otherwise Moderated Or Unmoderated

REFER ALSO TO CITATION(S) 33792, 34815

2105 Power Reactors, Breeding

REFER ALSO TO CITATION(S) 33755, 33757, 33973, 34029, 34044, 34045, 34046, 34047, 34051, 34072, 34073, 34098, 34510

34000 **(CONF-860722—6) Design rule for fatigue of welded joints in elevated-temperature nuclear components.** O'Connor, D.G.; Corum, J.M. (Oak Ridge National Lab., TN (USA)). 1986. Contract AC05-84OR21400. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86007569.

From ASME pressure vessel and piping conference and exhibit; Chicago, IL, USA (20 Jul 1986).

Elevated-temperature weldment fatigue failures have occurred in several operating liquid-metal reactor plants. Yet, ASME Code Case N-47, which governs the design of such plants in the United States, does not currently address the Code Subgroup on Elevated Temperature Design recently proposed a fatigue strength reduction factor for austenitic and ferritic steel weldments. The factor is based on a variety of weld metal and weldment fatigue data generated in the United States, Europe, and Japan. This paper describes the factor and its bases, and it presents the results of confirmatory fatigue tests conducted at Oak Ridge National Laboratory on 316 stainless steel tubes with axial and circumferential welds of 16-8-2 filler metal. These test results confirm the suitability of the design factor, and they support the premise that the metallurgical notch effect produced by yield strength variations across a weldment is largely responsible for the observed elevated-temperature fatigue strength reduction.

34001 **(CONF-860724—2) Bowing of core assemblies in advanced liquid metal fast reactors.** Kamal, S.A.; Orechwa, Y. (Argonne National Lab., IL (USA)). 1986. Contract W-31-109-ENG-38. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86007460.

From ASME/ANS bi-annual nuclear power conference: safe and reliable nuclear power plants; Philadelphia, PA, USA (20 Jul 1986).

Two alternative core restraint concepts are considered for a conceptual design of a 900 MWth liquid metal fast reactor core with a heterogeneous layout. The two concepts, known as limited free bowing and free flowering, are evaluated based on core bowing criteria that emphasize the echancement of inherent reactor safety. The core reactivity change during a postulated loss of flow transient is calculated in terms of the lateral displacements and displacement-reactivity-worths of the individual assemblies. The NUBOW-3D computer code is utilized to determine the assembly deformations and interassembly forces that arise when the assemblies are subjected to temperature gradients and irradiation induced creep and swelling during the reactor operation. The assembly ducts are made of the ferritic steel HT-9 and remain in the reactor core for four-years at full power condition. Whereas both restraint systems meet the bowing criteria, a properly designed limited free bowing system appears to be more advantageous than a free flowering system from the point of view of enhancing the reactor inherent safety.

34002 **(HEDL-SA—3480-FP) Economic benefits of power factor correction at a nuclear facility.** Boger, R.M.; Dalos, W.; Juguilon, M.E. (Hanford Engineering Development Lab., Richland, WA (USA)). 15 Jan 1986. Contract AC06-76FF02170. 5p. (CONF-860705—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE86009413.

From IEEE Power Engineering Society summer meeting; Mexico City, Mexico (20 Jul 1986).

The economic benefits of correcting poor power factor at an operating nuclear facility are shown. A project approach for achieving rapid return of investment without disrupting plant availability is described. Examples of technical problems associated with using capacitors for power factor correction are presented.

34003 **(NUREG/CR—4595) Enhancements to the LAFM computer code.** Baars, R.E. (Los Alamos National Lab., NM (USA)). Apr 1986. Contract W-7405-ENG-36. 25p. (LA—10711-MS). NTIS, PC A02/MF A01 - GPO. File Number TI86011597.

Significant modifications to the Los Alamos Failure Model (LAFM) computer code are described. The material in this report is limited to changes made since a description of LAFM was published in 1979. The most significant improvement allows continuation of the calculation beyond exhaustion of void space within the cladding. Updated input instructions also are included.

34004 **(ORNL—6133) Recommended reforms in codes and standards, quality assurance, and engineering practices for competitive liquid metal nuclear power plants.** Harms, W.O. (comp.). (Oak Ridge National Lab., TN (USA)). Apr 1986. Contract AC05-84OR21400. 93p. NTIS, PC E04/MF A01; GPO Dep. File Number DE86011351.

Includes 3 sheets of 24x reduction michofiche.

Recommendations are presented on LMFBR: codes and standards; quality assurance requirements and practices; and engineering practices. (JDB)

34005 Fast reactor power plant design having heat pipe heat exchanger. Huebotter, P. R.; McLennan, G. A. (to The United States of America as represented by the United States Department of Energy). US Patent 4,560,533. 24 Dec 1985. Filed date 30 Aug 1984. vp.

PAT-APPL-645654.

The invention relates to a pool-type fission reactor power plant design having a reactor vessel containing a primary coolant (such as liquid sodium), and a steam expansion device powered by a pressurized water/steam coolant system. Heat pipe means are disposed between the primary and water coolants to complete the heat transfer therebetween. The heat pipes are vertically oriented, penetrating the reactor deck and being directly submerged in the primary coolant. A U-tube or line passes through each heat pipe, extended over most of the length of the heat pipe and having its walls spaced from but closely proximate to and generally facing the surrounding walls of the heat pipe. The water/steam coolant loop includes each U-tube and the steam expansion device. A heat transfer medium (such as mercury) fills each of the heat pipes. The thermal energy from the primary coolant is transferred to the water coolant by isothermal evaporation-condensation of the heat transfer medium between the heat pipe and U-tube walls, the heat transfer medium moving within the heat pipe primarily transversely between these walls.

34006 Evacuate and backfill apparatus and method. Oakley, D. J.; Groves, O. J. (to The United States of America as represented by the Secretary of the United States Department of Energy). US Patent 4,558,982. 17 Dec 1985. Filed date 27 Jun 1984. vp.

PAT-APPL-625325.

An apparatus and method for treatment of hollow articles by evacuating existing gas or gases therefrom and purging or backfilling the articles with a second gas such as helium. The apparatus includes a sealed enclosure having an article storage drum mounted therein. A multiplicity of such articles are fed singly into the enclosure and loaded into radial slots formed in the drum. The enclosure is successively evacuated and purged with helium to replace the existing gas in the articles with helium. The purged articles are then discharged singly from the drum and transported out of the enclosure.

34007 Sodium compatibility of HT-9 and Fe-9 Cr-1 Mo steels. Anantatmula, R.P.; Brehm, W.F. (Rockwell Hanford Operations, Richland, WA). *Transactions of the American Nuclear Society;* **50**: 259(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

It was necessary to determine the corrosion and mass transport characteristics of the higher chromium ferritic steels in high-velocity, high-temperature sodium in order to fully qualify these materials for liquid-metal fast breeder reactor fuel cladding and ducts. Previous work with 2.5 Cr-1 Mo steels and a limited amount of information on the higher chromium steels showed good sodium corrosion resistance of the materials, but a tendency for severe decarburization of the 2.5 Cr-1 Mo steels. Sodium compatibility experiments were run with tubing specimens at described conditions. These results show that from sodium compatibility considerations, HT-9 steel is acceptable for cladding and ducts at temperatures to 650°C, and Fe-9 Cr-1 Mo is acceptable for ducts at up to 600°C.

34008 Dynamic stability experiments in sodium-heated steam generators. France, D.M.; Roy, R.; Carlson, R.D.; Chiang, T. (Argonne National Lab., IL, USA). pp 195-201 of Liquid metal engineering and technology. 3 Vols. Proceedings of the 3. international conference held in Oxford on 9-13 April 1984. Vol. 2. London, England; British Nuclear Energy Society (1984). (CONF-840411—).

From 3. meeting on liquid metal in energy applications; Oxford, UK (9 Apr 1984).

Seventy-two dynamic stability tests were performed in the sodium-heated boiling-water test facility at Argonne National Laboratory. A full-scale LMFBR steam generator tube was employed as the test section operating over the water parameter ranges of 6.9 to 15.9 MPa pressure and 170 to 800 kg/m^{2}s mass flux. The stability thresholds from the tests compared well to the predictions of a modified version of a correlation equation recently published by other investigators. Typical experimental data and the modified correlation equation are presented.

34009 Computer analysis of sodium cold trap design and performance. McPheeters, C.C.; Raue, D.J. (Argonne National Lab., IL, USA). pp 371-378 of Liquid metal engineering and technology. 3 Vols. Proceedings of the 3. international conference held in Oxford on 9-13 April 1984. Vol. 2. London, England; British Nuclear Energy Society (1984). (CONF-840411—).

From 3. meeting on liquid metal in energy applications; Oxford, UK (9 Apr 1984).

Normal steam-side corrosion of steam-generator tubes in Liquid Metal Fast Breeder Reactors (LMFBRs) results in liberation of hydrogen. Most of this hydrogen diffuses through the tubes into the heat-transfer sodium and must be removed by the purification system. Cold traps are normally used to purify sodium, and they operate by cooling the sodium to temperatures near the melting point, where soluble impurities including hydrogen and oxygen precipitate as NaH and Na_2O, respectively. A computer model was developed to simulate the processes that occur in sodium cold traps. The Model for Analyzing Sodium cold Traps (Mascot) can simulate most configurations of packing materials and dimensions, and it calculates pressure drops, flow distributions, temperature profiles, impurity concentration profiles, and impurity mass distributions. The accuracy of the model was checked by comparing calculated mass distributions with experimentally determined mass distributions from literature publications and with results from our own cold trap experiments. The comparisons were good to excellent in all cases.

34010 Overview of thermal-buoyancy-induced phenomena in reactor plant components. Kasza, K.E.; Kuzay, T.M.; Oras, J.J. (Argonne National Lab., IL, USA). pp 187-194 of Liquid metal engineering and technology. 3 Vols. Proceedings of the 3. international conference held in Oxford on 9-13 April 1984. Vol. 1. London, England; British Nuclear Energy Society (1984). (CONF-840411—).

From 3. meeting on liquid metal in energy applications; Oxford, UK (9 Apr 1984).

Studies related to delineating the influence of thermal-buoyancy forces on the thermal-hydraulics of liquid metal fast breeder reactor plant components under low-flow thermal transient and steady-state conditions have generated unique information that will aid design of these components. Various buoyancy-force-induced phenomena such as thermal stratification, flow recirculation, stagnation, and channelling are described and the importance to component performance is discussed. The water-based studies have been conducted in the Mixing Components Test Facility, a large multiprogram facility capable of performing generic studies of fluid flow and heat transfer in reactor components under programmed transient and steady-state conditions.

34011 Acoustic leak detection development in the USA. Greene, D.A.; Malovrh, J.W.; Magee, P.M.; Dixon, D.R.; Randall, R.L.; Claytor, T.N. (General Electric Co., Schenectady, NY, USA. Advanced Reactor Systems Dept.; Rockwell International Corp., Golden, CO, USA. Energy Systems Group; Argonne National Lab., IL, USA). pp 129-136 of Liquid metal engineering and technology. 3 Vols. Proceedings of the 3. international conference held in Oxford on 9-13 April 1984. Vol. 1. London, England; British Nuclear Energy Society (1984). (CONF-840411—).

From 3. meeting on liquid metal in energy applications; Oxford, UK (9 Apr 1984).

Acoustic monitoring systems that detect and locate a leak of water/steam from a defective tube in an LMFBR steam generator have been developed in the United States. A low frequency (approx. 10 KHz) system was developed by General Electric, and a high frequency (200 to 300 KHz) system by Rockwell International with support from Argonne National Laboratory. A comprehensive base technology program provided absolute signal amplitudes, background noise amplitudes, and signal source-to-detector transfer functions. Field tests of these systems demonstrated an ability to detect and locate simulated leaks under operating and quiescent conditions in an LMFBR steam generator.

34012 **Chemical thermodynamics of Cs and Te fission-product interactions in irradiated LMFBR mixed-oxide fuel pins.** Adamson, M.G.; Aitken, E.A.; Lindemer, T.B. (General Electric Co., Pleasanton, CA). pp 78-79 of IUPAC conference on chemical thermodynamics. Hamilton, Ontario; McMaster University (1984). (CONF-840807—).

From Conference on chemical thermodynamics and 39. calorimetry conference; Hamilton, Canada (13 Aug 1984).

A combination of fuel chemistry modelling and equilibrium thermodynamic calculations has been used to predict the atom ratios of Cs and Te fission products, n(Cs)/n(Te), that find their way into the fuel-cladding interface region of irradiated stainless steel-clad mixed-oxide fast breeder reactor fuel pins. It has been concluded that the ratio of chemically associated Cs and Te in the interface region, which in turn determines the Te activity, is controlled by an equilibrium reaction between Cs_2Te and the oxide fuel, and that the value of n(Cs)/n(Te) is, depending on fuel O/M, either equal to or slightly less than 2. Since Cs and Te fission products are both implicated as causative agents in FCCI (fission product-assisted inner surface attack of stainless steel cladding) and in FPLME (fission product-assisted liquid metal embrittlement of AISI-Type 316 stainless steel), the observed out-of-pile n(Cs)/n(Te) dependences of FCCI and FPLME incidence and severity, and their particular Cs, Te synergisms, are analyzed in terms of (Cs + Te) thermochemistry and phase equilibria. Successful rationalization in the case of FPLME is taken to point up the critical importance of Te activity and (Cs + Te) physical state in the FPLME mechanism. Also included in the paper is an updated chemical evolution model for reactive/volatile fission product behavior in irradiated oxide pins.

34013 **US fast reactor materials and structures program.** Harms, W.O.; Purdy, C.M. Metals Park, OH; American Society for Metals (1984). 11p. Contract AC05-84OR21400.

From ASM conference on materials for future energy systems; Washington, DC, USA (1-4 May 1984).

Materials and structures problems are central to many critical issues concerning the economic competitiveness, reliable performance, and safety of liquid metal fast breeder reactor (LMFBR) power plants. The US Department of Energy has sponsored for many years a national LMFBR materials and structures program. The objectives of the program are (1) to provide the technological basis for assuring that LMFBR components and systems will be free from significant structural failures during their design lifetimes and (2) to develop materials, design methods and criteria, materials property data, and procedures - all aimed at providing for broad flexibility in LMFBR component and system design and operation. Technology areas included in the program are high-temperature structural design; seismic design; mechanical properties design data; fabrication; tribology (friction, wear, and self-welding); coolant technology (sodium and steam/water); advanced structural alloys; and nondestructive testing. It is the purpose of this study to indicate briefly for each of the program's technology areas the objective, the scope, and some significant accomplishments. Future directions for the program are also discussed.

2106 Power Reactors, Auxiliary, Mobile, Package, And Transportable

34014 **(AD-A—955062/5/XAB) Design analysis of a prepackaged nuclear power plant for an ice-cap location.** (Alco Products, Inc., Schenectady, NY (USA)). 15 Jan 1959. 523p. (APAE—39). NTIS, PC A22/MF A01.

2107 Regulation And Licensing

REFER ALSO TO CITATION(S) 33983, 34152, 34153

34015 **(NUREG—0040-Vol.10-No.1) Licensee contractor and vendor inspection status report. Quarterly report, January-March 1986. Volume 10, No. 1.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Quality Assurance, Vendor and Technical Training Center Programs). May 1986. 152p. NTIS, PC A08/MF A01 - GPO. File Number TI86901432.

The NRC vendor inspection focus has been shifted to vendor activities associated with nuclear plant operation, maintenance, and modifications, more than firms designing nuclear steam supply systems, architect engineering firms designing nuclear plants, and major equipment vendors. Results of 16 inspections are reported, giving for each organization inspected, their activity, inspection bases and scope, and any violations, nonconformances, or unresolved items found. The status of previous inspection findings are also given. (LEW)

2108 Economics

REFER ALSO TO CITATION(S) 33780, 34170

34016 **Surveillance robot for nuclear power plants.** White, J.R.; Harvey, H.W.; Satterlee, P.E. Jr. (Remote Technology Corp., Oak Ridge, TN). *Transactions of the American Nuclear Society;* **50**: 606-607(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

A demonstration project to determine the feasibility and cost-effectiveness of mobile surveillance robots in nuclear power plants is being conducted by the Remote Technology Corporation (REMOTEC) for the US Nuclear Regulatory Commission. Phase I of the project was completed in March 1984 and included a survey of currently used robotic equipment and the development of a robotics application methodology. Three Tennessee Valley Authority plants were analyzed to identify specific plant areas with a high potential for surveillance robotics. Based on these results, a number of robotic system applications were prepared and evaluated for cost-effectiveness. The system with the highest potential, a mobile surveillance robot, was selected for fabrication and in-plant demonstration testing in a phase II effort. The design, fabrication, and assembly of SURBOT has been completed and cold testing is in process. It will be installed at the Browns Ferry Nuclear Plant early in 1986 for demonstration testing. Current projections are that SURBOT can be used in ~40 rooms within the auxiliary building and will have annual savings of over 100 person-rem exposure, 1000 sets of C-zone clothing, and 1000 person-hours of labor.

34017 **Some recent advances in remotely operated examination and maintenance equipment.** Kruse, P.W. (Combustion Engineering, Inc., Windsor, CT). *Transactions of the American Nuclear Society;* **50**: 612-613(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

This paper describes briefly some examples of advanced remotely operated examination and maintenance equipment now in use or under development by Combustion Engineering (C-E). It then describes in more detail the GENESIS system for steam generator inspection and maintenance.

2109 Process Heat Reactors

REFER ALSO TO CITATION(S) 34059

22 NUCLEAR REACTOR TECHNOLOGY

2202 Components And Accessories

REFER ALSO TO CITATION(S) 34081, 34082, 34305, 34510, 34669

34018 **(EGG-M—29685) NRC sponsored rotating equipment vibration research: a program description and progress report.** Nitzel, M.E. (EG and G Idaho, Inc., Idaho Falls (USA)). 1986. Contract AC07-76ID01570. 8p. (CONF-860722—8). NTIS, PC A02/MF A01 - GPO. File Number TI86009097.

From ASME pressure vessel and piping conference and exhibit; Chicago, IL, USA (20 Jul 1986).

The Idaho National Engineering Laboratory (INEL) is currently involved in a research project sponsored by the United States Nuclear Regulatory Commission (NRC) regarding operational vibration in rotating equipment. The object of this program is to assess the nature of vibrational failures and the effect that improved qualification standards may have in reducing the incidence of failure. In order to limit the scope of the initial effort, safety injection (SI) pumps were chosen as the component group for concentrated study. The task has been oriented to addressing the issues of whether certain SI pumps experience more failures than others, examining the dynamic environments in operation, examining the adequacy of current qualification standards, and examining what performance parameters could be used more efficiently to predict degradation or failure. Results of a literature search performed to survey SI pump failures indicate that failures are due to a diversity of causes, many of which may not be influenced by qualification criteria. Cooperative efforts have been undertaken with a limited number of nuclear utilities to describe the variety of possible operating environments and to analyze available data. The results of this analysis as they apply to the research issues are presented and possibilities for the future direction of the program are discussed.

34019 (INIS-mf—10111, pp 24) **Use of gamma spectrometry in monitoring radionuclide transport in the fuel element control system outside the reactor.** Bena, J.; Burclova, J.; Barta, O. (Vyskumny Ustav Jadrovych Elektrarni, Jaslovske Bohunice, Czechoslovakia; Ustav Jaderneho Vyzkumu CSKAE, Rez, Czechoslovakia). May 1985. (In Slovak). NTIS (US Sales Only), PC A03/MF A01. File Number DE86701997. (CONF-8505256—Absts.).

From IAA conference on instrumental activation analysis; Klucenice, Czechoslovakia (12 May 1985).

34020 **(SAND—86-1114C) Alternative containment integrity test methods. An overview of possible techniques.** Spletzer, B.L. (Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 16p. (CONF-860507—4). NTIS, PC A02/MF A01 - GPO. File Number TI86010993.

From 3. workshop on integrity of containments for nuclear power plants; Washington, DC, USA (21 May 1986).

A study is being conducted to develop and analyze alternative methods for testing of containment integrity. The study is focused on techniques for continuously monitoring containment integrity to provide rapid detection of existing leaks, thus providing greater certainty of the integrity of the containment at any time. The study is also intended to develop techniques applicable to the currently required Type A integrated leakage rate tests. A brief discussion of the range of alternative methods currently being considered is presented. The methods include applicability to all major containment types, operating and shutdown plant conditions, and quantitative and qualitative leakage measurements. The techniques are analyzed in accordance wihth the current state of knowledge of each method. The bulk of the techniques discussed is in the conceptual stage, have not been tested in actual plant conditions, and are presented here as a possible future direction for evaluating containment integrity.

34021 **Approximating complex gamma spectra for shielding calculations.** Shure, K. (Bettis Atomic Power Lab., West Mifflin, PA). *Transactions of the American Nuclear Society;* 50: 445-446(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

In the process of reactor shielding design, gamma-ray sources from fission and neutron capture both in the core and external to it have to be determined and taken into account. The designer, having decided on the spatial distribution of fission and capture events, must then assign a spectral distribution to the gamma radiation released in each event. Current sophisticated Monte Carlo and discrete ordinate transport programs make use of very many group representations of detailed spectra available from Evaluated Nuclear Data File (ENDF) libraries. There may be instances ,when the designer wishes to use point kernel programs or analytic formulas for obtaining estimates of gamma-ray dose rates or energy deposition rates in materials for a one-dimensional representation of the shield. The purpose of this paper is to discuss two possible means for approximating these detailed spectra for such applications as well as how to access the reliability of dose and energy deposition rate results so obtained.

34022 **Example calculations illustrating methods for analyzing ductile flaw stability in nuclear pressure vessels.** Merkle, J.G.; Johnson, R.E. (Oak Ridge National Lab., TN). *International Journal of Pressure Vessels and Piping;* 18: 35-53(1985). Contract W-7405-ENG-26.

This paper contains example calculations of ductile flaw instability stresses for hypothetical flaws in nuclear pressure vessels. For comparison, three different methods of estimating upper shelf toughness as a function of Charpy impact energy were used, namely a power law R-curve correlation, the Rolfe-Novak correlation, and the Paris J_{50} correlation. All three methods were used in LEFM calculations including a plastic zone size correction, and gave similar results, with the Paris J_{50} method being the most conservative at low Charpy upper shelf energy levels. Safety factors based on the tearing modulus ratio T/sub mat//T/sub appl/ can exceed those based on load by considerable amounts and use of them at this time is not recommended. The use of resistance curve data obtained from actual vessel material test specimens is recommended over the use of correlations. Furthermore, evaluation of a recently proposed modified crack extension adjustment procedure for R-curve data, which is not over-conservative, is recommended. 4 references, 3 figures, 2 tables.

34023 **RELAP5/MOD1.5 analysis of steam line break transients for a 3-loop and a 4-loop Westinghouse nuclear steam supply system.** Peeler, G.B.; McDonald, T.A.; Kennedy, M.F. (Argonne National Lab., IL). pp 13-21 of Proceedings of the international conference on power plant simulation. Fernandez-del-Busto, R.; Hetrick, D.L.; Mendez, E. (eds.). Cuernavaca, Mexico; Instituto de Investigaciones Electricas (1984). (CONF-841115—).

From International conference on power plant simulation; Mexico City, Mexico (19 Nov 1984).

RELAP5/MOD1.5 (Cycle 31 and 34) calculations were made to assess the assumptions used by Westinghouse (W) to analyze mainsteam line break transients. Models of a W 3-loop and 4-loop nuclear steam supply system were used. Sensitivity studies were performed to determine the effect of the availability of offsite power, break size and initial core power. Comparison with W results indicated that if the assumptions used by W are replicated within the RELAP5 framework, then the W methodology for prediction of the Nuclear Steam Supply System (NSSS) response is conservative for steam line break transients. In developing the 4-loop plant model, a three loop W plant model was modified at ANL into a four loop plant. This plant model retained the two loop nodalization of the original model, but split them such that one loop represented the faulted steam generator (broken at the outlet just past the integral flow restrictor) while the other loop represented all three of the intact loops. In the case of the 3-loop plant model, a RELAP5 model was modified to perform this replication calculation. One loop represented the faulted steam generator (broken between the steam generator and the non-integral flow restrictor) while the other loop represented the remaining two intact loops. In both cases (3-loop and 4-loop), the reactor vessel was modelled as two parallel channels to accommodate the Westinghouse steam line break methodology.

34024 **MINET validation study using steam generator test data.** Van Tuyle, G.J.; Guppy, J.G. (Brookhaven National Lab., Upton, NY). pp 328-333 of Proceedings of the international conference on power plant simulation. Fernandez-del-Busto, R.; Hetrick, D.L.; Mendez, E. (eds.). Cuernavaca, Mexico; Instituto de Investigaciones Electricas (1984). (CONF-841115—).

From International conference on power plant simulation; Mexico City, Mexico (19 Nov 1984).

Three steam generator transient test cases that were simulated using the MINET computer code are described, with computed results compared against experimental data. The MINET calculations closely agreed with the experiment for both the once-through and the U-tube steam generator test cases. The effort is part of an ongoing effort to validate the MINET computer code for thermal-

hydraulic plant systems transient analysis, and strongly supports the validity of the MINET models.

2203 Fuel Elements

REFER ALSO TO CITATION(S) 34280, 34305, 34537

34025 **Weldment for austenitic stainless steel and method.** Bagnall, C.; McBride, M. A. (to The United States of America as represented by the Department of Energy). US Patent 4,558,202. 10 Dec 1985. Filed date 17 Aug 1983. vp. PAT-APPL-523992.

For making defect-free welds for joining two austenitic stainless steel members, using gas tungsten-arc welding, a thin foil-like iron member is placed between the two steel members to be joined, prior to making the weld, with the foil-like iron member having a higher melting point than the stainless steel members. When the weld is formed, there results a weld nugget comprising melted and then solidified portions of the joined members with small portions of the foil-like iron member projecting into the solidified weld nugget. The portions of the weld nugget proximate the small portions of the foil-like iron member which project into the weld nugget are relatively rich in iron. This causes these iron-rich nugget portions to display substantial delta ferrite during solidification of the weld nugget which eliminates weld defects which could otherwise occur. This is especially useful for joining austenitic steel members which, when just below the solidus temperature, include at most only a very minor proportion of delta ferrite.

34026 **Automated closure system for nuclear reactor fuel assemblies.** Christiansen, D. W.; Brown, W. F. (to The United States of America as represented by the United States Department of Energy). US Patent 4,542,267. 17 Sep 1985. Filed date 30 Nov 1982. vp. PAT-APPL-445620.

A welder for automated closure of fuel pins by a pulsed magnetic process in which the open end of a length of cladding is positioned within a complementary tube surrounded by a pulsed magnetic welder. Seals are provided at each end of the tube, which can be evacuated or can receive tag gas for direct introduction to the cladding interior. Loading of magnetic rings and end caps is accomplished automatically in conjunction with the welding steps carried out within the tube.

2204 Control Systems

REFER ALSO TO CITATION(S) 34052

34027 **(DOE/NE—0064) Artificial intelligence and nuclear power. Report by the Technology Transfer Artificial Intelligence Task Team.** (USDOE Assistant Secretary for Nuclear Energy, Washington, DC). Jun 1985. 89p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86011387.

The Artificial Intelligence Task Team was organized to review the status of Artificial Intelligence (AI) technology, identify guidelines for AI work, and to identify work required to allow the nuclear industry to realize maximum benefit from this technology. The state of the nuclear industry was analyzed to determine where the application of AI technology could be of greatest benefit. Guidelines and criteria were established to focus on those particular problem areas where AI could provide the highest possible payoff to the industry. Information was collected from government, academic, and private organizations. Very little AI work is now being done to specifically support the nuclear industry. The AI Task Team determined that the establishment of a Strategic Automation Initiative (SAI) and the expansion of the DOE Technology Transfer program would ensure that AI technology could be used to develop software for the nuclear industry that would have substantial financial payoff to the industry. The SAI includes both long and short term phases. The short-term phase includes projects which would demonstrate that AI can be applied to the nuclear industry safely, and with substantial financial benefit. The long term phase includes projects which would develop AI technologies with specific applicability to the nuclear industry that would not be developed by people working in any other industry.

34028 **(IAE—4047/4) Neutron absorbtion by the system of cylindrical rods.** Lobyntsev, V.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1984. 19p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE86702188.

The system of rods used in the VGR-50 type reactor as a regulator is considered. Analytical expressions for absorption probability and non-collision probability are obtained. These expressions shown an evident dependence on system parameters: number of rods, their radius, rod position radius and channel radius in which they are transfered. Formulas are derived for black rods in the empty channel. The system is submerged in a homogeneous neutron flux.

34029 **Use of a steam leak simulator in EBR-II.** McKee, J.M.; Osterhout, M.M.; Batten, R.L. (Argonne National Lab., IL, USA; Argonne National Lab., Scoville, ID, USA). pp 115-119 of Liquid metal engineering and technology. 3 Vols. Proceedings of the 3. international conference held in Oxford on 9-13 April 1984. Vol. 1. London, England; British Nuclear Energy Society (1984). (CONF-840411—).

From 3. meeting on liquid metal in energy applications; Oxford, UK (9 Apr 1984).

A steam leak simulator has been installed on EBR-II to periodically test and calibrate the steam-generator leak detection system. Measured amounts of molten anhydrous sodium hydroxide are injected at controlled rates simulating leaks in the range of 0.024 to 0.16 g H_2O/s. Experience with 11 injections over an 18 month period is described.

34030 **Nuclear Plant Analyzer: an interactive TRAC/RELAP power-plant simulation program.** Steinke, R.; Booker, C.; Giguere, P.; Liles, D.; Mahaffy, J.; Turner, M.; Wiley, R. (Los Alamos National Lab., NM). pp 127-136 of Proceedings of the international conference on power plant simulation. Fernandez-del-Busto, R.; Hetrick, D.L.; Mendez, E. (eds.). Cuernavaca, Mexico; Instituto de Investigaciones Electricas (1984). (CONF-841115—).

From International conference on power plant simulation; Mexico City, Mexico (19 Nov 1984).

The Nuclear Plant Analyzer (NPA) is a computer-software interface for executing the TRAC or RELAP5 power-plant systems codes. The NPA is designed to use advanced supercomputers, long-distance data communications, and a remote workstation terminal with interactive computer graphics to analyze power-plant thermal-hydraulic behavior. The NPA interface simplifies the running of these codes through automated procedures and dialog interaction. User understanding of simulated-plant behavior is enhanced through graphics displays of calculational results. These results are displayed concurrently with the calculation. The user has the capability to override the plant's modeled control system with hardware adjustment commands. This gives the NPA the utility of a simulator, and at the same time, the accuracy of an advanced, best-estimate, power-plant systems code for plant operation and safety analysis.

34031 **Current issues and trends on the use of simulation in nuclear power plant disturbance analysis systems.** Madrid, A.; Guarro, S. (International Atomic Energy Agency, Vienna, Austria). pp 151-163 of Proceedings of the international conference on power plant simulation. Fernandez-del-Busto, R.; Hetrick, D.L.; Mendez, E. (eds.). Cuernavaca, Mexico; Instituto de Investigaciones Electricas (1984). (CONF-841115—).

From International conference on power plant simulation; Mexico City, Mexico (19 Nov 1984).

A review of current simulation techniques applied to disturbance analysis systems (DAS) for on-line diagnosis of abnormal conditions and operator support in nuclear power plants is made; and, insufficient representation of dynamic effects in current DAS concepts is addressed. The Logic Flowgraph Methodology (LFM) is shown to be a flexible and efficient synthetic simulation language, with capability to handle relevant dynamic effects and automatically construct in real time the diagnostic tree(s) identifying the root cause(s) of actual disturbances, and the appropriate recovery

action(s) or alternate success path(s), for on-line DAS implementation. Fairly comprehensive LFM models for a PWR pressurizer system and a BWR high pressure core spray (HPCS) system are presented and discussed, and the latest version of the LFM tree synthesis routine, optimized to achieve reduction of computer memory usage, is employed to show the LFM diagnoses of selected hypothetical disturbances with/without reactor scram occurrence. LFM capability for identification of valve position indicator failures is addressed. Some implications inherent to DAS implementation in developing countries in regard to local simulation capabilities are discussed.

34032 **Dynamic simulator for nuclear power plants (DSNP): development, verification and expansion of modules.** Larson, H.A.; Dean, E.M.; Koenig, J.F.; Gale, J.G.; Lehto, W.K. (Argonne National Lab., Idaho Falls, ID). pp 353-358 of Proceedings of the international conference on power plant simulation. Fernandez-del-Busto, R.; Hetrick, D.L.; Mendez, E. (eds.). Cuernavaca, Mexico; Instituto de Investigaciones Electricas (1984). (CONF-841115—).

From International conference on power plant simulation; Mexico City, Mexico (19 Nov 1984).

The DSNP Simulation Language facilitates whole reactor plant simulation and design. Verification of DSNP includes modeling of plant experiments in Experimental Breeder Reactor No. 2 (EBR-II) as well as comparison of DSNP results with verified simulation programs. Considerable flexibility allows expansion of the DSNP language and accommodation of other computer system simulation languages. The component modules of DSNP, contained in libraries, are continually updated with new, improved, and verified modules. The modules are used to simulate the dynamic response of LMFBR reactor systems to upset and transient conditions, with special emphasis on investigations of inherent shutdown mechanisms.

34033 **Potential utilities of optimal estimation and control in nuclear power plants.** Tylee, J.L.; Purviance, J.E. (EG & G Idaho, Inc., P.O. Box 1625, Idaho Falls, Idaho 83415). pp 171-176 of Advances in instrumentation. Volume 38. Research Triangle Park, NC; Instrument Society of America (1983). (CONF-8310102—).

From Instrument Society of America conference and exhibit; Houston, TX, USA (10 Oct 1983).

Optimal estimation and control theories offer the potential for more precise control and diagnosis of nuclear power plants. The important element of these theories is that a mathematical plant model is used in conjunction with the actual plant data to optimize some performance criteria. These criteria involve important plant variables and incorporate a sense of the desired plant performance. Several applications of optimal estimation and control to nuclear systems are discussed.

2205 Environmental Aspects

REFER ALSO TO CITATION(S) 34814, 34815, 34816, 34905

34034 (KAERI/RR—450/84, pp 25-27, 74-85, 190) **Environmental impact assessment during the operation of Kori nuclear power plant.** Lee, Jeong Ho; Lee, Hyun Duk; Lee, Young Bok; Lee, Kang Suk; Ahn, Jong Sung; You, Byung Sun; Kim, Byung Woo; Choi, Yong Ho; Kim, Sang Bok; Han, Moon Hee. (Korea Advanced Energy Research Inst., Daeduk, Republic of Korea). Apr 1985. (In Korean). NTIS (US Sales Only), PC A23/MF A01. File Number DE86780463.

In Studies on the safety assessment for environmental radiation and radioactivity (I).

This project was carried out to facilitate and systematize the governmental regulatory activities for the environmental safety against the utility. To ensure the environmental safety of nuclear power facilities, assessment of environmental radioactivities around Kori nuclear power plants is one of the primary concerns in evaluating the environmental impacts. Therefore, this project was conducted to carry out the assessment of the environmental impact due to radioactive effluents by analyzing data collected extensively from Kori area. Available data for environmental radioactivities were collected and systematically rearranged. By comparing the results with the pre-operational measurements and that of the case in other countries, environmental impacts were analyzed and assessed. Assessment of environmental radiations and radioactivities around Kori area, on the whole, showed no significant differences regionally and yearly. From the comparison of post-operational measurements with those in the pre-operational state, it was concluded that there was no environmental radioactive contamination due to nuclear power plant operation.

34035 **Sludge suspension system for flat bottom tanks.** Kaczmarsky, M.M.; Hobbs, A.O.; Fennell, K. (TTI Engineering, Norwood, MA). *Transactions of the American Nuclear Society;* **50**: 590-592(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

The accumulation of sludge at the bottom of flat bottom radioactive waste tanks, and the inability to effectively and safely remove the sludge, is a common problem at nuclear powerplants. A unique and innovative system for tank agitation/desludging was developed for the waste collector tank (WCT) at Carolina Power and Light's Brunswick steam electric plant. The system makes use of three flexible, yet durable, hoses moving back and forth along the bottom of the tank, providing mechanical sweeping agitation at the bottom and jet spray agitation at the perimeter. The driving force for the hoses is provided by recirculated tank water partially diverted from the WCT pump discharge. The sludge suspension system (SSS) was determined to be an effective mechanism to either prevent solids from settling and, therefore, accumulating at the bottom of the tank, or resuspending small levels of accumulated sludge from the tank bottom. The SSS will provide effective tank agitation while minimizing installation costs, maintenance, and operator efforts. A brief discussion of costs and benefits is provided along with a discussion of the advantageous application of the SSS at nuclear and non-nuclear industrial facilities.

34036 **On-site transfer system for remote handling of low-level radioactive waste.** Schmoker, Duane S. (Nuclear Packaging, Inc., Federal Way, WA). *Transactions of the American Nuclear Society;* **50**: 614-615(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

Increased uncertainties regarding the future availability of low-level radioactive waste (LLW) disposal sites have caused many commercial nuclear power utilities to investigate and implement alternatives to radwaste storage and disposal. Nuclear Packaging, Inc., under contract to Southern California Edison has developed an on-site radioactive waste transfer system (OTS), which allows shielded handling of LLW at the San Onofre Nuclear Generating Station. The system is designed to remotely transfer multiconfigured radwaste containers into shielded storage modules, on-site radioactive waste storage facilities, or shipping casks. The OTS consists of three primary components: (a) a shielded transfer cask, (b) a transport trailer, and (c) a mobile straddle crane for remote handling and positioning of the transfer cask during container transfer operations.

34037 **Development of a data base management system for environmental radioactivity data.** Stafford, M.W.; Bolch, W.; Bolch, E. (Radiological Site Assessment Program, Oak Ridge Associated Universities, Oak Ridge, TN 37831-0117). pp 3017-3024 of Computer applications in health physics. Kathren, R.L.; Higby, D.P.; McKinney, M.A. Richland, WA; Health Physics Society (1984). (CONF-840202—).

From 17. midyear topical meeting of the Health Physics Society; Pasco, WA, USA (5 Feb 1984).

A major difficulty in assessing environmental radioactivity data is the time consuming effort involved in organizing these data in a proper format for reporting. While conducting the environmental radiological surveillance for the Crystal River Nuclear Power Plant, the University of Florida Department of Environmental Engineering Sciences addressed this problem by utilizing a minicomputer to develop a family of interactive FORTRAN-IV codes to organize, edit, and report yearly data. The system is capable of automated input of analytical results to easily addressable direct

access data files. A common algorithm calculates the position of the data deduced from a series of questions regarding sample type and collection frequency. All results are accessible for viewing or editing if required. Tables can be generated by "menu driven" command file that enables the user to construct monthly and annual reports with analytical results in summary table format specified by NRC Regulatory Guide 4.8.

34038 **Interactive and automated systems for nuclear track measurements with applications to fast neutron dosemetry.** Roberts, J.H.; Gold, R.; McNeece, J.P.; Preston, C.C.; Ruddy, F.H. (Westinghouse Hanford Co., Hanford Engineering Development Lab., Richland, WA 99352). pp 13-27 of Computer applications in health physics. Kathren, R.L.; Higby, D.P.; McKinney, M.A. Richland, WA; Health Physics Society (1984). (CONF-840202—).

From 17. midyear topical meeting of the Health Physics Society; Pasco, WA, USA (5 Feb 1984).

Interactive and automatic track measuring systems have been developed primarily for fast neutron dosemetry in and around reactors. The interactive system is used for proton recoil measurements in nuclear research emulsions and the automatic systems for counting fission fragment tracks in Muscovite mica. The status of these systems, along with illustrative applications, are presented, particularly with regard to their relationship to neutron personnel dosemetry.

2206 Research, Test, And Experimental Reactors

REFER ALSO TO CITATION(S) 34084, 34814

34039 **(CONF-860724—1) Structural analysis of fuel assembly clads for the Upgraded Transient Reactor Test Facility (TREAT Upgrade).** Ewing, T.F.; Wu, T.S. (ETA, Inc., Westmont, IL (USA); Argonne National Lab., IL (USA)). 1986. Contract W-31-109-ENG-38. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86006452.

From ASME/ANS bi-annual nuclear power conference: safe and reliable nuclear power plants; Philadelphia, PA, USA (20 Jul 1986).

The Upgraded Transient Reactor Test Facility (TREAT Upgrade) is designed to test full-length, pre-irradiated fuel pins of the type used in large LMFBRs under accident conditions, such as severe transient overpower and loss-of-coolant accidents. In TREAT Upgrade, the central core region is to contain new fuel assemblies of higher fissile loadings to maximize the energy deposition to the test fuel. These fuel assemblies must withstand normal peak clad temperatures of 850°C for hundreds of test transients. Due to high temperatures and gradients predicted in the clad, creep and plastic strain effects are significant, and the clad structural behavior cannot be analyzed by conventional linear techniques. Instead, the detailed elastic-plastic-creep behavior must be followed along the time-dependent load history. This paper presents details of the structural evaluations of the conceptual TREAT Upgrade fuel assembly clads.

34040 **(EGG-M—29585) Vibrational measurements of line-mounted equipment on the LOFT feedwater system.** Ware, A.G.; Nitzel, M.E. (EG and G Idaho, Inc., Idaho Falls (USA)). 1986. Contract AC07-76ID01570. 5p. (CONF-860722—9). NTIS, PC A02/MF A01 - GPO. File Number TI86009077.

From ASME pressure vessel and piping conference and exhibit; Chicago, IL, USA (20 Jul 1986).

As part of the NRC/EG and G Equipment Qualification Program, the vibration response of the Loss of Fluid Test (LOFT) feedwater system was monitored to determine spectral acceleration levels typical for line mounted equipment. Accelerometers were placed on the main feedwater pump, three valves, and one piping support. The response of the system was monitored using a two channel analyzer. Measurements were recorded at four power levels as reactor power was increased from the source range to 64% of full power. The resulting spectra show responses up to 3000 Hz. Observations concerning the data were made by computing and evaluating the Fourier transforms for the test. Maximum spectral amplitudes of 0.05 to 0.4 gs rms were recorded. Typical measurements were 0.1 to 0.2 gs rms at the maximum peaks. Major responses occurred at the pump motor frequency (59.5 Hz) and at multiples of diffuser vanes and impeller blades. Broadband response attributed to fluid turbulence was observed from 500 to 1500 Hz. Except at the pump frequency, only negligible response was observed below 100 Hz. No correlation of response level vs. feedwater flowrate was detected. Examples of Fourier spectra of the feedwater system components are included in the paper. These are considered typical of those which would be expected in a nuclear plant auxiliary feedwater system.

34041 **(ORNL/TM—6345/R2) Technical specifications for the bulk shielding reactor.** (Oak Ridge National Lab., TN (USA)). May 1986. Contract AC05-84OR21400. 51p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86011348.

This report provides information concerning the technical specifications for the Bulk Shielding Reactor. Areas covered include: safety limits and limiting safety settings; limiting conditions for operation; surveillance requirements; design features; administrative controls; and monitoring of airborne effluents. 10 refs.

34042 **(ZfK—563) Irradiation handbook for the Rossendorf Research Reactor (RFR).** Schneider, B. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). Aug 1985. 84p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE86702190.

The present irradiation handbook gives a survey of the irradiation possibilities of the Rossendorf Research Reactor and of the conditions which have to be taken into consideration during irradiations. The irradiation equipment and the expected irradiation parameters are presented. Special attention is directed to the physical processes and the problems of irradiation safety. The reader is also given information about basic laws, organisational problems and terms of waste treatment.

34043 **In-core and ex-core calculations of the VENUS simulated PWR benchmark experiment.** Williams, M.L.; Chowdhury, P.; Landesman, M.; Kam, F.B.K. (Louisiana State Univ., Baton Rouge). *Transactions of the American Nuclear Society;* **50**: 438-440(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

The VENUS pressurized water reactor (PWR) engineering mockup experiment was established to simulate a beginning-of-life, generic PWR configuration at the zero-power VENUS critical facility located at CEN/SCK in Mol, Belgium. The reactor contains Zircaloy-clad, low-enriched UO_2 pins in a light water moderator. The size and pitch of the pins are consistent with modern PWR cores. The VENUS rectangular core region is surrounded by a steel baffle, followed by a water reflector, a simulated core barrel, a simulated thermal shield, and a simulated downcomer region, respectively. The US Nuclear Regulatory Commission has supported dosimetry measurements and calculations in this Belgium-sponsored benchmark experiment as part of its light water (LWR) reactor pressure vessel (RPV) surveillance dosimetry improvement program to determine the accuracy to which neutron and gamma responses can be calculated in a prototypic LWR environment.

34044 **Subassembly duct cutting in the FFTF/IEM cell.** Gibbons, P.W. (Westinghouse Hanford Co., Richland, WA). *Transactions of the American Nuclear Society;* **50**: 585-586(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

After irradiation in the Fast Flux Test Facility (FFTF), certain driver fuel assemblies (DFA) are selected for disassembly in the interim examination and maintenance (IEM) cell for further examination elsewhere. Cutting operations near fuel pins are delicate evolutions, and inadvertent penetrations of pin claddings have occurred. Improved features related to precise and reliable position control that have been incorporated into the FFTF cutters are described. The IEM cell cutters have proven to be effective tools in DFA processing.

34045 Large remote manipulator operating and maintenance experience at the IEM cell. Hicks, D.F.; McGuinness, P.W. (Westinghouse Hanford Co., Richland, WA). *Transactions of the American Nuclear Society;* **50**: 598-599(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

The interim examination and maintenance (IEM) cell at the Fast Flux Test Facility contains two large electromechanical manipulators (EMMs), the pedestal and wall-mounted manipulators (PMM and WMM) with 136 and 68 kg of capacity, respectively. Since their installation, the EMMs have been essential for cell maintenance and operation. A significant percentage of the total cell maintenance effort has been required to keep the WMM and PMM operational. Since June 1981, 142 maintenance requests were written for the EMMs, an average of 34 per year. The EMM's were manufactured by an outside vendor specifically for the IEM cell. The EMMs underwent acceptance testing at the IEM cell after initial installation and trouble shooting were performed by Westinghouse Hanford Company and the vendor. As a consequence, the requirements of the specification were fully met. The paper is a summary of the IEM cell's EMM operation and maintenance experience.

34046 Nuclear fuel assembly identification using computer vision. Moffett, S.D. (Westinghouse Hanford Company, Richland, WA). *Transactions of the American Nuclear Society;* **50**: 599-600(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

This report describes an improved method of remotely identifying irradiated nuclear fuel assemblies. The method uses existing in-cell TV cameras to input an image of the notch-coded top of the fuel assemblies into a computer vision system, which then produces the identifying number for that assembly. This system replaces systems that use either a mechanical mechanism to feel the notches or use human operators to locate notches visually. The system was developed for identifying fuel assemblies from the Fast Flux Test Facility (FFTF) and the Clinch River Breeder Reactor, but could be used for other reactor assembly identification, as appropriate.

34047 Fuel assembly cooling experience at the FFTF IEM cell. McGuinness, P.W. (Westinghouse Hanford Company, Richland, WA). *Transactions of the American Nuclear Society;* **50**: 600-601(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

To date, 13 fuel assemblies requiring forced cooling have been processed through the Fast Flux Test Facility (FFTF) interim examination and maintenance (IEM) cell. Of these, two assemblies experienced overtemperature conditions due to inadequate forced cooling. Both of the occurrences have contributed significantly to the process of learning how to operate a fuel assembly cooling system remotely in an argon atmosphere hot cell. Many innovations have been made to the cooling system to enhance safety and increase productivity, and are briefly described.

2207 Plutonium And Isotope Production Reactors

34048 (DPSP—85-14-2-RM) Raw materials. Monthly report, Savannah River Plant. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Atomic Energy Div.). Feb 1985. Contract AC09-76SR00001. 48p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85016454.

Information is presented concerning the processing of Mark 31A depleted uranium slugs; fabrication of uranium-aluminum fuel tubes; waste monitors; equipment maintenance; environmental projects; and tritium projects review.

34049 (DPST—85-1-7) Savannah River Laboratory monthly report, July 1985. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Jul 1985. Contract AC09-76SR00001. 14p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86008910.

Activities are reported for the nuclear reactor technology and scientific computations efforts; the chemical processes and environmental technology programs; and defense wastes, naval fuel, and laboratory operations. (DCC)

2209 Reactor Safety

REFER ALSO TO CITATION(S) 33774, 34427, 34820

34050 (BMI—1985-094) Summarizing evaluation of the core catcher device (SR 209) based on existing comments and on analytical results. Final report. Bracht, K. (Bundesministerium des Innern, Bonn (Germany, F.R.); Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Dec 1985. 90p. (In German). (GRS-A—1029). NTIS (US Sales Only), PC A05/MF A01. File Number DE86752039.

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

Special emphasis was drawn upon the efficiency, realiziation ability to function and upon adverse effects of the equipment. The final results of these discussions and investigations are summarized in this report. Predominantly the core catcher can become effective only for accident sequence with an initially tight containment and late fission product release into the environment. With respect to new results concerning fission product release it is to be expected that the device can mitigate the consequences of core meltdown accident only to a limited extent. The ability of the conceptual design to function seems to be doubtful for several reasons, i.g. due to uncertainties in the behaviour of the melt in the catcher. The design does not or only insufficiently cover invessel melt accident scenarios on high pressure conditions, which are relevant sequences with respect to their high contribution to core melt frequency. The concept may have considerable negative consequences on the course of meltdown accidents, and also on the design and the operation of a plant. Implementation of the device is expected to need extreme and inadequate effort with respect to its limited efficiency upon accident mitigation. The core catcher, being described in SR 209 is considered to be not recommendable for accident mitigation. (orig./HP).

34051 (BMI—1985-095) Calculation of local temperature distributions and their uncertainties in fast breeder reactor (SNR-300) fuel elements. Final report. Quast, U.; Martens, K.H. (Bundesministerium des Innern, Bonn (Germany, F.R.); Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Dec 1985. 74p. (In German). (GRS-A—1055). NTIS (US Sales Only), PC A04/MF A01. File Number DE86752041.

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

The computer code COBRA-IIIM and its method of subchannel analysis for computation of the temperature distribution within heated rod bundels are briefly described, likewise the whole plant model 'Super System Code' SSC. With its help the plant behaviour of a liquid metal fast breeder reactor can be simulated during the course of transients. The performed COBRA subchannel analysis describe a 1/12-section of the central fuel element. Results are shown from steady state COBRA analysis with the quantitative calculation of local temperature changes as the result of statistical distributed tolerances in the fuel element manufacturing. They are mentioned in statistical hot channel analysis. Nonsteady subchannel analysis were made for the SNR-300. Two characteristic accidents, the maximum reactivity insertion by malfunction of all control and trim rods and the emergency power case, were investigated. A comparison with results, as they are evaluated with common methods by superpositioning the coolant temperature rises of steady subchannel analysis and nonsteady results for a representative channel shows good agreement. A straight comparison of nonsteady and with timedependent boundary conditions for power and flow rate steadily performed subchannel analyses yields larger differences in the emergency power case. Thereby with regard to maximum temperatures and temperature gradients the steady calculations give always conservative results. (orig./HP).

34052 (CONF-8310143—75) Safety implications of control systems. Smith, O.L. (Oak Ridge National Lab., TN (USA)). 1983. Contract AC05-84OR21400. 18p. NTIS, PC A02/MF A01 - GPO. File Number TI86011060.

From 11. NRC water reactor safety research information meeting; Gaithersburg, MD, USA (14 Oct 1983).

The Safety Implications of Control Systems Program has three major activities in support of USI-A47. The first task is a failure mode and effects analysis of all plant systems which may potentially induce control system disturbance that have safety implications. This task has made a preliminary study of overfill events and recommended cases for further analysis on the hybrid simulator. Work continues on overcooling and undercooling. A detailed investigation of electric power network is in progress. LERs are providing guidance on important failure modes that will provide initial conditions for further simulator studies. The simulator taks is generating a detailed model of the control system supported by appropriate neutronics, hydraulics, and thermodynamics submodels of all other principal plant components. The simulator is in the last stages of development. Checkout calculations are in progress to establish model stability, robustness, and qualitative credibility. Verification against benchmark codes and plant data will follow.

34053 (DOE/NE/34109—T1) Research and development activities on Three Mile Island Unit Two. Annual report for 1985. (GPU Nuclear Corp., Middletown, PA (USA); EG and G Idaho, Inc., Idaho Falls (USA)). Apr 1986. Contract GI01-84NE34109. 96p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86011045.

The year 1985 was significant in the cleanup of Three Mile Island Unit 2 (TMI-2). Major milestones in the project included lifting the plenum assembly from the reactor vessel and the start of operations to remove the damaged fuel from the reactor. This report summarizes these milestones and other TMI-2 related cleanup, research, and development activities. Other major topics include the following: waste immobilization and management; fuel shipping cask delivery and testing; sample acquisition and evaluation; and decontamination and dose reduction. 26 figs.

34054 (EPRI-NP—4498-Vol.1) Reactor analysis support package (RASP). Volume 1. Introduction and overview. Final report. Sorensen, J.M. (ed.). (Levy (S.), Inc., Campbell, CA (USA)). Apr 1986. 426p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920294.

The experience of recent years has demonstrated an ever-increasing need for utilities operating nuclear power plants to have the means to re-analyze those postulated events that form the bases for plant operation or safety design. The Reactor Analysis Support Package (RASP) provides an integrated, interlinked, and validated code package satisfying a wide range of nuclear utility applications. RASP consolidates existing core physics, thermal-hydraulics, and fuel performance computer codes into an integrated and self-consistent system. The RASP project also involves producing several guideline documents and conducting seminars/workshops to assist the utilities in applying the RASP code package. This report provides a RASP overview that is useful both as an introduction for the inexperienced nuclear power plant analyst and as a reference guide for analysis staff management and the experienced analyst. The discussions of potential RASP applications, analysis qualification, reload licensing evaluations, and quality assurance should also be useful to utility management who are planning their staffing requirements. An effort was made to keep this report as succinct as practicable while still providing the level of detail adequate to satisfy the report's objectives. 34 figs., 24 tabs.

34055 (EPRI-NP—4532) Critical flow through small pipe breaks. Final report. Anderson, J.L.; Benedetti, R.L. (EG and G Idaho, Inc., Idaho Falls (USA)). May 1986. Contract AC07-76ID01570. 169p. NTIS, PC E11/MF A1235; 1 - Research Reports Center, Box 50490, Palo Alto, CA 94303; GPO Dep. File Number DE86010907.

A series of experiments have been performed investigating the phenomena of liquid entrainment and vapor pull-through at a tee junction between a horizontal pipe and a small branchline. These experiments were performed under conditions of stratified steam-water flow at 3.4, 4.4, and 6.2 MPa in the 28.4 cm diameter mainline, and critical flow through a nozzle installed in the branchline. Two orientations of the branchline were investigated: horizontal and vertical downflow. This report documents the experimental program, presents the data obtained, and discusses correlations for predicting the levels at which the onset of vapor pull-through and liquid entrainment occur and correlations for predicting the flow quality into the branchline. 27 refs., 95 figs., 25 tabs.

34056 (EPRI-NP—4556) Qualified database for the critical flow of water. Final report. Ilic, V.; Banerjee, S.; Behling, S. (California Univ., Santa Barbara (USA). Dept. of Chemical and Nuclear Engineering). May 1986. 156p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920318.

A review of available data from critical flow experiments with water as the test fluid was carried out. The reviewed data have been incorporated in a data base. The experimental conditions ranged from subcooled to saturated fluid over a wide range of pressure. The data were evaluated to determine their suitability for use in developing and/or evaluating analytical models used in critical flow calculations. A small fraction of the data were found to be useful for detailed flow modeling with the bulk of the data useful for conventional models. About one-third of the data reviewed had large uncertainties associated with them or incomplete specification of experimental conditions. This latter group could not be recommended for use in assessing or developing analytical models. 87 refs., 9 figs.

34057 (EPRI-NP—4558-SR) Fourth International RETRAN Conference. Proceedings. Agee, L.J.; Naser, J.A. (eds.). (Electric Power Research Inst., Palo Alto, CA (USA)). May 1986. 764p. (CONF-8511130—). Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920290.

From 4. international RETRAN meeting; Tampa, FL, USA (11 Nov 1985).

The RETRAN computer code, developed by EPRI through its Contractor, Energy Incorporated (EI), is now being widely used by the international nuclear community for various types of safety analysis. In order to exchange information concerning the current use of the code by the various organizations, EPRI and EI jointly sponsored the Fourth International RETRAN Meeting in Tampa, Florida, on November 11-13, 1985. The opening session featured a panel discussion on "Analyses to Assist Plant Operations" by representatives from GPU, CmwED, INPO and EPRI. During the three-day meeting, 26 technical papers were presented by the various participants. The papers can be generally classified as: RETRAN development, verification and analysis of non-LWR systems; RETRAN analysis of PWRs; and RETRAN analysis of BWRs.

34058 (INIS-mf—10133) Ratification and implementation of two protocols amending respectively the Paris Convention of 29th July 1960 and the Brussels Convention of 31st January 1963, each already amended by Additional Protocols of 28th January 1964, and both dealing with third party liability in the field of nuclear energy, signed in Paris on 16th November 1982. (International Atomic Energy Agency, Vienna (Austria)). 15 Apr 1985. 1p. (In Italian). NTIS (US Sales Only), PC A02/MF A01. File Number DE86702201.

Published in the Italian Official Gazette No. 85 (Gazzetta Ufficiale).

This Act, adopted by the President of the Republic on 5th March 1985 authorises ratification by Italy of the 1982 Protocols to amend the Paris Convention on Third Party Liability in the Field of Nuclear Energy and the Brussels Convention Supplementary to the Paris Convention. The Act came into force on the day following its publication.

34059 (Juel-Spez—333) Studies on accidents with massive water ingress using the PNP-500 pebble bed reactor. Moormann, R. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Nukleare Sicherheitsforschung). Oct 1985. 39p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE86752051.

The computer code REACT/THERMIX is used for analyses focussed on graphite corrosion processes. A correct reactor shutdown is assumed; the mass of water ingressing into the primary circuit is varied between 1000 and 7500 kg (that means up to hypothetical values). The dependence of accident consequences on parameters as intensity and starting time of the afterheat removal system or kinetic values of the chemical processes is examined. The results show, that also under pessimistic assumptions the extent of the graphite corrosion is relatively low; significant damaging of the fuel elements or of the graphite components does not occur. A primary circuit depressurization in combination with a local burning of water gas would probably not affect the fission product retention potential of the (gas-tight) containment. Summing up, the risk caused by these accidents remains small. (orig./HP).

34060 **(KFK—4004) Experimental modal survey of a vertical cylindrical shell partly filled with water.** Eberle, F.; Kadlec, J.; Hailfinger, G.; Scharnowell, R. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Nukleare Sicherheit). Jan 1986. 80p. NTIS (US Sales Only), PC A05/MF A01. File Number DE86752035.

The report deals with an experimental modal survey of a vertical cylindrical shell, requested for experimental verification of the SING-S coupled fluid/structure-interaction computer program. The eigenfrequencies, the mode shapes and the critical damping ratios of the test cylinder used (diameter 1000 x 3 x 1600 mm, empty or partly filled with water, water level 1350 mm) were extracted from the set of simultaneously measured relaxation response signals. The response was achieved via a snapback process. The EVA computer program was used to extract the modal characteristics from the acceleration response signals. A total number of 93 eigenmodes were identified. A secondary objective was the experimental verification by means of a comparative modal survey of the extraction subroutines of the EVA computer program. The modified relaxation procedure with preselected excitation frequencies, the single point random excitation procedure, and the impact method were successively applied to furnish the supplementary modal characteristics needed for the comparison. They yielded consistent results confirming the correctness of all four experimental and evaluation procedures used. (orig./HP).

34061 **(NUREG—0797-Suppl.13) Safety Evaluation Report related to the operation of Comanche Peak Steam Electric Station, Units 1 and 2 (Docket Nos. 50-445 and 50-446). Supplement No. 13.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). May 1986. 72p. NTIS, PC A04/MF A01 - GPO. File Number TI86901459.

Supplement 13 to the Safety Evaluation Report related to the operation of Comanche Peak Steam Electric Station (CPSES), Units 1 and 2 (NUREG-0797), has been prepared by the Office of Nuclear Reactor Regulation of the US Nuclear Regulatory Commission (NRC). The facility is located in Somervell County, Texas, approximately 40 miles southwest of Fort Worth, Texas. This supplement presents the staff's evaluation of the Comanche Peak Response Team (CPRT) Program Plan which was formulated by the applicant to resolve various construction and design issues raised by the Atomic Safety and Licensing Board, allegers, intervenor Citizens Association for Sound Energy (CASE), NRC inspections of various types, and Cygna Energy Services while conducting its independent design assessment. The NRC staff concludes that the CPRT Program Plan provides an overall structure for addressing all existing issues and any future issues which may be identified from further evaluations, and if properly implemented will provide important evidence of the design and construction quality of CPSES, and will identify any needed corrective action. The report identifies items to be addressed by the NRC staff during the implementation phase.

34062 **(NUREG—0954-Suppl.6) Safety Evaluation Report related to the operation of Catawba Nuclear Station, Units 1 and 2 (Docket Nos. 50-413 and 50-414). Supplement No. 6.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). May 1986. 25p. NTIS, PC A02/MF A01 - GPO. File Number TI86901429.

This report supplements the Safety Evaluation Report (NUREG-0954) issued in February 1983 by the Office of Nuclear Reactor Regulation of the US Nuclear Regulatory Commission with respect to the application filed by Duke Power Company, North Carolina Municipal Power Agency Number 1, North Carolina Membership Corporation, Saluda River Electric Cooperative, Inc., and Piedmont Municipal Power Agency, as applicants and owners, for licenses to operate the Catawba Nuclear Station, Units 1 and 2 (Docket Nos. 50-413 and 50-414, respectively). The facility is located in York County, South Carolina, approximately 9.6 km (6 miles) north of Rock Hill and adjacent to Lake Wylie. This supplement provides additional information supporting the license for operation above 5% power and power ascension to full-power operation for Unit 2.

34063 **(NUREG—1057-Suppl.1) Safety evaluation report related to the operation of Beaver Valley Power Station, Unit 2 (Docket No. 50-412).** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). May 1986. 91p. NTIS, PC A05/MF A01 - GPO. File Number TI86901442.

This report, Supplement No. 1 to the Safety Evaluation Report for the application filed by the Duquesne Light Company et al. (the applicant) for a license to operate the Beaver valley Power Station, Unit 2 (Docket No. 50-412), has been prepared by the Office of Nuclear Reactor Regulation of the US Nuclear Regulatory Commission. This supplement reports the status of certain items that had not been resolved at the time the Safety Evaluation Report was published.

34064 **(NUREG—1175) NRC safety research in support of regulation. Selected highlights.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research). May 1986. 48p. NTIS, PC A03/MF A01 - GPO. File Number TI86901361.

The report presents selected highlights of how research has contributed to the regulatory effort. It explains the research role of the NRC and nuclear safety research contributions in the areas of: pressure vessel integrity, piping, small- and large-break loss-of-coolant accidents, hydrogen and containment, source term analysis, seismic hazards and high-level waste management. The report also provides a summary of current and future research directions in support of regulation.

34065 **(NUREG/CR—3262-Vol.7) COBRA-NC: a thermal hydraulics code for transient analysis of nuclear reactor components. Volume 7. Assessment manual for containment applications.** Wheeler, C.L.; Thurgood, M.J.; Guidotti, T.E.; DeBellis, D.E. (Pacific Northwest Labs., Richland, WA (USA)). Apr 1986. Contract AC06-76RL01830. 249p. (PNL—5515-Vol.7). NTIS (US Sales Only), PC A11/MF A01 - GPO. File Number TI86010802.

COBRA-NC is a digital computer program written in FORTRAN IV that simulates the response of nuclear reactor components and systems to thermal-hydraulic transients. The code solves the multicomponent compressible, three-dimensional, two-fluid, three-field equations for two-phase flow. The three fields are the vapor/gas field, the continuous liquid field, and the liquid drop field. This volume of the manual provides the user with the results of comparisons between COBRA-NC predictions and data obtained from containment systems experiments. These data comparisons provide an indication of the code's ability to predict the response of multicompartment nuclear containment systems to postulated loss-of-coolant accidents that result in the release of steam, water, and/or noncondensable gases into nuclear containments. 10 refs., 207 figs., 59 tabs.

34066 **(NUREG/CR—3702) Buoyancy effects in overcooling transients calculated for the NRC pressurized thermal shock study.** Theofanous, T.G.; Iyer, K.; Nourbakhsh, H.P.; Gherson, P. (Purdue Univ., Lafayette, IN (USA). School of Nuclear Engineering). May 1986. 278p. NTIS, PC A13/MF A01 - GPO. File Number TI86901449.

The thermal-hydraulic responses of three PWRs (Oconee, Calvert Cliffs, and H.B. Robinson), to postulated Pressurized Ther-

mal Shock (PTS) scenarios, which were originally determined by RELAP5 and TRAC calculations, are being further developed here with regard to buoyancy/stratification effects. These three PWRs were the subject of the NRC PTS study, and the present results helped define the thermal-hydraulic conditions utilized in the fracture mechanics calculations carried out at ORNL. The computer program REMIX, which is based on the Regional Mixing Model (RMM), was the analytical tool employed, while Purdue's 1/2-Scale HPI Thermal Mixing facility provided the basis for experimental support. Important mixing and wall heat transfer regimes are delineated on the basis of these results. We conclude that stratification is important only in cases of complete loop stagnation and that mixed-convection effects are important for downcomer flow velocities below ~0.25 m/s. The stratification is small in magnitude, however it is important in creating a recirculating flow pattern which activates the lower plenum, pump and loop seal volumes, to participate in the mixing process. This mixing process together with the heat input from the wall metal significantly impact the cooldown rates. Heat transfer in the plume region is dominated by forced convection. On the other hand, the presence of the Reactor Pressure Vessel (RPV) wall cladding and wall conduction significantly dampen the free convection effects in the low velocity, mixed-convection, regime. For the stagnant loop cases, all locations outside the plume region are included in this regime. In the presence of natural loop circulation and a uniformly distributed downcomer flow, the mixed convection regime is also expected, however, the forced convection regime can also be observed in highly asymmetric flow behavior.

34067 (NUREG/CR—3770) Preliminary development of an integrated approach to the evaluation of pressurized thermal shock as applied to the Oconee Unit 1 Nuclear Power Plant. Burns, T.J.; Cheverton, R.D.; Flanagan, G.F.; White, J.D.; Ball, D.G.; Lamonica, L.B.; Olson, R. (Oak Ridge National Lab., TN (USA)). May 1986. Contract AC05-84OR21400. 716p. (ORNL/TM—9176). NTIS, PC A99/MF A01 - GPO. File Number TI86011205.

An evaluation of the risk to the Oconee-1 nuclear plant due to pressurized thermal shock (PTS) has been Completed by Oak Ridge National Laboratory (ORNL). This evaluaion was part of a Nuclear Regulatory Commission (NRC) program designed to study the PTS risk to three nuclear plants: Oconee-1, a Babcock and Wilco reactor plant owned and operated by Duke Power Company; Calvert Cliffs-1, a Combustion Engineering reactor plant owned and operated by Baltimore Gas and Electric company; and H.B. Robinson-2, a Westinghouse reactor plant owned and operated by Carolina Power and Light Company. Studies of Calvert Cliffs-1 and H.B. Robinson-2 are still underway. The specific objectives of the Oconee-1 study were to: (1) provide a best estimate of the probability of a through-the-wall crack (TWC) occurring in the reactor pressure vessel as a result of PTS; (2) determine dominant accident sequences, plant features, operator and control actions and uncertainty in the PTS risk; and (3) evaluate effectiveness of potential corrective measures.

34068 (NUREG/CR—3805-Vol.3) Engineering characterization of ground motion. Task II. Observational data on spatial variations of earthquake ground motion. Volume 3. Chang, C.Y.; Power, M.S.; Idriss, I.M.; Somerville, P.G.; Silva, W.; Chen, P.C. (Woodward-Clyde Consultants, Walnut Creek, CA (USA); Interpacific Technology, Inc., Oakland, CA (USA)). Feb 1986. 295p. NTIS, PC A13/MF A01 - GPO. File Number TI86901156.

This report presents the results of part of a two-task study on the engineering characterization of earthquake ground motion for nuclear power plant design. The overall objective of this research program sponsored by the US Nuclear Regulatory Commission (USNRC) is to develop recommendations for methods for selecting design response spectra or acceleration time histories to be used to characterize motion at the foundation level of nuclear power plants. Volume 3 presents observational data on spatial variations of earthquake ground motion.

34069 (NUREG/CR—4290-Vol.1) Probability of pipe failure in the reactor coolant loops of Babcock and Wilcox PWR plants. Volume 1. Summary report. Holman, G.S.; Chou, C.K. (Lawrence Livermore National Lab., CA (USA)). May 1986. Contract W-7405-ENG-48. 69p. (UCRL—53644-Vol.1). NTIS, PC A04/MF A01 - GPO. File Number TI86011174.

As part of its reevaluation of the double-ended guillotine break (DEGB) of reactor coolant piping as a design basis event for nuclear power plants, the US Nuclear Regulatory Commission (NRC) contracted the Lawrence Livermore National Laboratory (LLNL) to estimate the probability of occurrence of a DEGB, and to assess the effect that earthquakes have on DEGB probability. This report describes an evaluation of reactor coolant loop piping in PWR plants having nuclear steam supply systems designed by Babcock and Wilcox. Two causes of pipe break were considered: pipe fracture due to the growth of cracks at welded joints ("direct" DEGB), and pipe rupture indirectly caused by failure of heavy component supports due to an earthquake ("indirect" DEGB). Unlike in earlier evaluations of Westinghouse and Combustion Engineering reactor coolant loop piping, in which the probability of direct DEGB had been explicitly estimated using a probabilistic fracture mechanics model, no detailed fracture mechanics calculations were performed. Instead, a comparison of relevant plant data, mainly reactor coolant loop stresses, for one representative B and W plant with equivalent information for Westinghouse and C-E systems inferred that the probability of direct DEGB should be similarly low (less than 1e-10 per reactor year). The probability of indirect DEGB, on the other hand, was explicitly estimated for two representative plants. The results of this study indicate that the probability of a DEGB form either cause is very low for reactor coolant loop piping in these specific plants and, because of similarity in design, infer that the probability of DEGB is generally very low in B and W reactor coolant loop piping. The NRC should therefore consider eliminating DEGB as a design basis event in favor of more realistic criteria. 13 refs., 9 tabs.

34070 (NUREG/CR—4549) Determination of Appendix K conservatisms for large break LOCA in a Westinghouse PWR using TRAC-PD2/MOD1 code. Rohatgi, U.S.; Yuelys-Miksis, C.; Saha, P. (Brookhaven National Lab., Upton, NY (USA)). Apr 1986. Contract AC02-76CH00016. 111p. (BNL-NUREG—51967). NTIS, PC A06/MF A01 - GPO. File Number TI86010756.

A 200% cold leg break accident in a Westinghouse four-loop RESAR-3S plant has been analyzed using the best-estimate code TRAC-PD2/MOD1/Version 27 with updates. Three TRAC calculations have been performed. The first calculation used the best-estimate or realistic initial and boundary conditions and scenarios, while the other two calculations, one with and one without locked rotor resistance, used the licensing conditions. These calculations produced peak cladding temperatures (PCTs) of 800.5°K, 1072°K, and 1153°K, respectively. Comparison of these results with the Westinghouse licensing calculations performed in accordance with the guidelines in Appendix K of 10 FR50 shows an overall safety margin of 663°K, of which 352.5°K is due to the conservative initial and boundary conditions and scenario. The remaining 310.5°K is due to conservative physical models. The locked rotor resistance contributed about 81°K in PCT. 25 refs.

34071 (NUREG/CR—4581) Dryout front modeling for PWR thermal hydraulic analysis. Brown, D.; Griffith, P. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Mechanical Engineering). May 1986. 65p. NTIS, PC A04/MF A01 - GPO. File Number TI86901430.

An experimental and analytical study has been carried out on the effects of a steamline break on the heat transfer on the secondary side of a PWR U-tube steam generator. The study is focused on prediction of the dryout front location during blowdown. Prediction of the dryout front is essential for determining the wetted heat transfer area. The bulk of the heat transfer from the primary to secondary side occurs in the wetted area. To understand the behavior of the dryout front, an experiment using a simulated steam generator test facility was performed for a wide range of simulated steamline break sizes. The thermocouple data obtained from

the experiment was used to determine the dryout front propagation. Examination of the data provided guidelines for modeling the multiple water levels observed in the blowdown experiment. The blowdown was modeled using the computer code SIT-SG. In order to accurately predict the multiple water levels, the flooding characteristics of tube support plates were determined and input into the code. Using the predicted water levels and the thermocouple data, the dryout zone could then be determined. An empirical correlation for dryout zone height as a function of the superficial velocity of the vapor is presented. The zone turns out to be 0 to 8 inches in thickness. 41 figs.

34072 **(SAND—85-1274C) In-pile fuel freezing and penetration experiments. The ACRR TRAN experiments.** Gauntt, R.O.; Pickard, P.S.; Berthier, J.; Furutani, A.; Royl, P. (Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 6p. (CONF-860501—5). NTIS, PC A02/MF A01 - GPO. File Number TI86011186.

From Conference on the science and technology of fast reactor safety; Channel Islands, UK (12 May 1986).

The TRAN series of experiments focus on providing a data base for the evaluation of models of fuel removal phenomena during the transition phase of a CDA. Series I (5 tests) provided data for comparisons with existing analytic models of fuel freezing. The B-series (4 tests) focused on fuel removal through upper blanket structures. The GAP test involved a 1.7 Kg UO_2 melt to examine the potential for fuel removal through subassembly gaps. The TRAN tests showed a modified conduction model valid over a wide range of temperature, pressure and geometries. Based on these results, significant fuel removal is expected under many conditions in the transition phase of an LMFBR CDA. 13 refs., 10 figs.

34073 **(SAND—85-1279C) Guernsey fast reactor safety topical in-pile observations of fuel and clad relocation during LMFBR initiation phase accident experiments. The STAR experiments.** Wright, S.A.; Schumacher, G.; Henkel, P.R.; Royl, P. (Sandia National Labs., Albuquerque, NM (USA); Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.)). 1986. Contract AC04-76DP00789. 6p. (CONF-860501—3). NTIS, PC A02/MF A01 - GPO. File Number TI86010957.

From Conference on the science and technology of fast reactor safety; Channel Islands, UK (12 May 1986).

A series of seven in-pile experiments (the STAR experiments) were performed in which clad motion and fuel dispersal were observed in small pin bundles with high-speed cinematography. The experimental heating conditions reproduced a range of Loss of Flow (LLF) accident scenarios for the lead subassemblies in LMFBRs. The experiments show strong tendencies for limited clad motion in multiple pin bundles, early fuel disruption and dispersal (prior to fuel melting) in moderate power transients having simultaneous clad melting and fuel disruption. The more recent experiments indicate a possibility of steel vapor driven fuel dispersal after fuel breakup and intimate fuel/steel mixing. 16 refs.

34074 **(SAND—86-0704C) Leak behavior through EPAs under severe accident conditions.** Keck, J.D.; Thome, F.V. (Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 11p. (CONF-860507—3). NTIS, PC A02/MF A01 - GPO. File Number TI86010954.

From 3. workshop on integrity of containments for nuclear power plants; Washington, DC, USA (21 May 1986).

The leakage behavior of electrical penetration assemblies (EPAs) is being evaluated by varying the penetration type, manufacturer, and hypothetical temperature and pressure accident profile. Nuclear qualified EPAs were procured from D.G. O'Brien, Westinghouse, and Conax. Severe accident sequence analysis was used to generate the severe accident conditions (SAC) for a large dry PWR, a BWR Mark I drywell, and a BWR Mark III wetwell. The EPA manufacturers were matched to the reactor type based on a survey of EPAs used in reactors. The D.G. O'Brien EPA was chosen for the PWR SAC, the Westinghouse was chosen for the BWR Mark III, and the Conax was chosen for the BWR Mark I. The EPAs were radiation and thermal aged to a 40-year service life before the SAC test was conducted. For the D.G. O'Brien EPA SAC test, while there was no detectable leakage during the SAC test, there was a 0.13 scc/sec leak measured during the posttest inspection. For the Westinghouse EPA SAC test, there was no detectable leakage during or after the SAC test. The Conax EPA SAC test is scheduled for completion in July 1986.

34075 **Fuel washout detection system.** Colburn, R. P. (to The United States of America as represented by the United States Department of Energy). US Patent 4,560,529. 24 Dec 1985. Filed date 1 Feb 1983. vp.

PAT-APPL-462852.

A system for detecting grossly failed reactor fuel by detection of particulate matter as accumulated on a filter.

34076 **Rules of thumb and simplified methods.** Lahti, G.P. (Sargent & Lundy, Chicago, IL). *Transactions of the American Nuclear Society;* **50**: 444(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

The author points out the value of a thorough grounding in fundamental physics combined with experience of applied practice when using simplified methods and rules of thumb in shield engineering. Present-day quality assurance procedures and good engineering practices require careful documentation of all calculations. The aforementioned knowledge of rules of thumb and back-of-the-envelope calculations can assure both the preparer and the reviewer that the results in the quality assurance documentation are the physically correct ones.

34077 **Determination of radioactivity distribution in nuclear power plant systems.** Zobel, W. (Tennessee Valley Authority, Knoxville). *Transactions of the American Nuclear Society;* **50**: 444-445(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

When introducing radiation protection considerations into the design of nuclear power plants, additions to such plants, or backfits for regulatory or operational reasons, one is immediately faced with the necessity of determining the sources giving rise to the radiation field to be expected. In this context, fluids may be liquid or gaseous, and systems may include connected rooms in the plant as well as connected pipes or ducts. In most cases, one cannot rely on existing operating data, either because the facility has operated for only a relatively short period of time so that it is still clean, or because no data exist for the proposed modification and analogs are not available. It is then necessary to calculate the distribution of radioactivity throughout the proposed system or facility. This paper describes a computer program developed by the Tennessee Valley Authority to perform such calculations.

34078 **Modular code system using adjoint fluxes for calculating a three-dimensional dose map.** Pevey, R.E.; Waltz, W.R. (Savannah River Lab., Aiken, SC). *Transactions of the American Nuclear Society;* **50**: 446-447(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

This paper describes a modular code system that is a simple-to-use but accurate method for calculating personnel doses at various points in a processing area. The code system, called MODOS, is a composite model built from separate calculations of the radiation emitted by slab and cylinder source geometries, the transport of this radiation through parallel slab shields, and the transport of the radiation through empty space. The user can get a three-dimensional view of the radiation field in a work area.

34079 **Gamma dose from volume sources by a simple equation.** De Gangi, N.L.; Hodgdon, A.D.; Bartlett, E.B. (United Engineers & Constructors Inc., Philadelphia, PA). *Transactions of the American Nuclear Society;* **50**: 449-450(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

A simple relation for dose versus detector position relative to a cylindrical volume source is presented and is shown to be adequate for scoping calculations. It is suited for use by junior engineering and health physics staff.

34080 **Approximate methods in gamma-ray skyshine calculations.** Faw, R.E.; Roseberry, M.L.; Shultis, J.K. (Kansas State Univ., Manhattan). *Transactions of the American Nuclear Society;* 50: 450-451(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

Gamma-ray skyshine, an important component of the radiation field in the environment of a nuclear power plant, has recently been studied in relation to storage of spent fuel and nuclear waste. This paper reviews benchmark skyshine experiments and transport calculations against which computational procedures may be tested. The paper also addresses the applicability of simplified computational methods involving single-scattering approximations. One such method, suitable for microcomputer implementation, is described and results are compared with other work.

34081 **Penetration shielding applications of CYLSEC.** Dexheimer, D.T.; Hathaway, J.M. (Bechtel National Inc., San Francisco, CA). *Transactions of the American Nuclear Society;* 50: 451-452(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

Evaluation of penetration and discontinuity shielding is necessary to meet 10CFR20 regulations for ensuring personnel exposures are as low as reasonably achievable (ALARA). Historically, those shielding evaluations have been done to some degree on all projects. However, many early plants used conservative methods due to lack of an economical computer code, resulting in costly penetration shielding programs. With the increased industry interest in cost effectively reducing personnel exposures to meet ALARA regulations and with the development of the CYLSEC gamma transport computer code at Bechtel, a comprehensive effort was initiated to reduce penetration and discontinuity shielding but still provide a prudent degree of protection for plant personnel from radiation streaming. This effort was more comprehensive than previous programs due to advances in shielding analysis technology and increased interest in controlling project costs while maintaining personnel exposures ALARA. Methodology and resulting cost savings are discussed.

34082 **Simplified methods for gamma exposure fields transmitted through straight ducts.** Shultis, J.K.; Thompson, K.R.; Faw, R.E. (Kansas State Univ., Manhattan). *Transactions of the American Nuclear Society;* 50: 452-453(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

A frequently encountered problem in shield design is the calculation of the radiation field transmitted through a straight duct that is obliquely illuminated by a beam of gamma photons. While several computationally intensive techniques can yield good predictions for the general duct streaming problem, simplified methods have usually been restricted to the unrealistic case of the source and/or detector being on the duct centerline. In this paper, the application of simplified methods to predict the spatial variation of the transmitted radiation field from ducts obliquely illuminated by monoenergetic photons is discussed, and the comparison of the results to benchmark streaming data is presented.

34083 **Off-site dose evaluation of an independent spent fuel storage installation with a personal computer.** Smith, M.L.; Soong, P.Y.; Watson, L.W. (Virginia Power Co., Richmond). *Transactions of the American Nuclear Society;* 50: 457-458(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

Virginia Power plans to build an independent spent fuel storage installation (SIFSI) at the Surry power station site. Spent fuel, 5 yr or older, will be stored in dry casks, which, in turn, will be placed out of doors on concrete pads at the ISFSI. It is anticipated that four casks of spent fuel will be produced each year. The ISFSI may eventually contain a total of 84 casks on three concrete pads, which are located near an existing low-level waste facility (LLWF) building at Surry. The dry storage casks may be purchased from different manufacturers. To avoid repeated and lengthy analysis of each vendor's casks, a personal computer (PC) program has been developed in cooperation with Bechtel Power Corporation. This program evaluates the skyshine doses on site as well as off the site. The chosen calculational approach yields results capable of evaluating the shielding characteristics of any vendor's cask design for any site. Automation of the approach on the PC reveals the sensitivity of site selection to fuel management schedules, their impact on the fuel's source spectra, and the general strategy for the storage sequencing at the ISFSI. The program also is capable of generic man-rem evaluations.

34084 **Computer code to determine irradiated fuel self-protection times.** Schnitzler, B.G. (Idaho National Engineering Lab. Idaho Falls). *Transactions of the American Nuclear Society;* 50: 472-473(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

The Code of Federal Regulations (10CFR73.6) establishes requirements for the physical security (safeguards) of special nuclear material of moderate and low strategic significance. Irradiated fuel at nonpower reactor facilities may qualify for exemption from certain physical security requirements if the total external radiation dose can be shown to exceed 100 rem/h at a distance of 91.44 cm (3 ft) from any accessible surface without intervening shielding. This paper describes a methodology and computer program for assessment of total (gamma and beta) biological dose rates from irradiated fuels. The program provides a quick and inexpensive means of demonstrating dose rates in excess of the 100 rem/h required for fuel self-protection.

34085 **Teleoperators and remote devices for nuclear applications.** Pavelek, M.D. II. (Bechtel National Inc., Middletown, PA). *Transactions of the American Nuclear Society;* 50: 616(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

During the decontamination and recovery operations at Three Mile Island Unit 2 (TMI-2), it was decided that remote equipment could be used. The areas where remote equipment could be used to best advantage were evaluated. Two categories of remote equipment needs were developed: (a) robots and teleoperators and (b) fixed position remotely operated equipment. To date, seven teleoperators have been evaluated on-site at TMI-2 by GPU Nuclear personnel including: Herman; SISI (system in-service inspection); Oscar; Fred (Hodges remote-controlled mobile manipulator); Moose; Louie; and RRV-1 (remote reconnaissance vehicle). The RRV-2 has been received and is currently being tested and evaluated. Four of the teleoperators were successfully utilized for recovery operations at TMI-2.

34086 **TMI-2 defueling system design.** Bradbury, P. (Bectel National, Inc., Oak Ridge, TN). *Transactions of the American Nuclear Society;* 50: 616-618(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

Although many earlier studies had been conducted, the final definition of the Three Mile Island Unit 2 defueling system design commenced during the spring of 1984. It was at that time that two major efforts were undertaken: (1) definition of the sequence of operations needed to prepare the plant for start of defueling; and (2) selection of the overall defueling concept. It was determined that the preferred defueling concept would rely on manual tools, rather than robotic devices. This major decision resulted in the need to keep the refueling canal water level to a minimum, so as to enable closer access to the core region. As a result of this decision, it was necessary to provide for storage of the plenum assembly, once removed from the vessel, in the deep end of the canal, where it could still be submerged. This paper describes how these considerations, together with examination of the best available data on the core configuration, resulted in the final definition of the defueling system design.

34087 **Reliability analysis of the RRV-1 robot.** Gordon, J.W.; Curry, J.J. (FenPac, Inc., Brigantine, NJ). *Transactions of the American Nuclear Society;* 50: 618-619(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

The remote reconnaissance vehicle (RRV) has been deployed to take radiation readings and video recordings of the inaccessible basement elevation of the Three Mile Island Unit 2 reactor building. In the event of its failure, the RRV could not be manually retrieved due to the high radiation levels; thus, a reliability analysis was conducted to identify faults that could render the RRV irretrievable. A reliability improvement strategy based on the analysis results was developed and implemented. The analysis and conclusions are described in the paper.

34088 **Maintenance of remote reconnaissance vehicle.** Schein, D.C. (GPU Nuclear Corp., Middletown, PA). *Transactions of the American Nuclear Society;* **50**: 619-620(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

A description is provided of the maintenance program developed for remote reconnaissance vehicles, such as RRV-1, in use at the Three Mile Island Unit 2. The described approach, which is simple, effective, and flexible, helped to make the effort successful. It will be applied to future projects.

34089 **Remote equipment development at TMI-2.** Giefer, D.L. (Bechtel National Inc., Middletown, PA). *Transactions of the American Nuclear Society;* **50**: 620-621(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

The purpose of this work is to develop and implement remote equipment to be used to collect information and samples in preparation for work performance in a hazardous radioactive area. This equipment consists of a remotely controlled mobile six-wheeled transporter and support attachments. The attachments include a sludge samplers viewing equipment, radiation survey instruments, and concrete core drilling equipment. A spare base vehicle was obtained for training purposes. The device with attachments has been successfully used in the highly radioactive basement of the TMI-2 reactor building.

34090 **Remote sludge sampler.** Horiuchi, Y.; Giefer, D.L. *Transactions of the American Nuclear Society;* **50**: 621(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

The accident in March 1979 left the lower elevation of the Three Mile Island Unit 2 reactor building totally inaccessible by humans due to an ~8-ft depth of highly radioactive water. In the following 2 to 3 yr, the water was drained to a depth of ~3 to 5 in., leaving an anticipated layer of sludge on the floor surface. In November 1984, a remote reconnaissance vehicle (RRV-1) was lowered into this area for an inspection and radiation survey. During this inspection, a considerable amount of sludge was observed that varied up to a depth of ~5 in. The problem for GPU Nuclear Corporation was to collect samples of this sludge in order to evaluate the physical properties as well as its radiological properties. Some sludge samples have been collected in the past, but information resulting from RRV-1 entries have shown sludge deposits that have never been sampled. This paper discusses the design approach and operation of a sludge sampler designed to collect samples of this sludge.

34091 **Remote operating vehicle for TMI-2 basement recovery.** Whittaker, R. (Carnegie-Mellon Univ., Pittsburgh, PA). *Transactions of the American Nuclear Society;* **50**: 621-622(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

The remote core sampler is work tooling conceived to cut and to remove cylinders from concrete walls without human presence. It is transported, powered, and operated from the remote reconnaissance vehicle (RRV), whose initial missions explored the Three Mile Island Unit 2 (TMI-2) basement. The RRV missions mapped total field radiation at the surface of the basement walls. Now the pressing need is for a core sampling program to characterize the contaminants within the walls in order to plan cleanup operations. While conventional coring methods are mature and well understood, all positioning, forcing, sensing, and thinking for standard coring are done by humans at close proximity. The conditions that prevail in the basement of TMI-2 preclude humans and necessitate the first coring from a remote core sampler. The remote core sampler has been tested in mock-up conditions aboard the RRV, and it is viewed as a viable candidate for use in the nuclear environment. The ultimate measure of its relevance will be performance in a severe recovery situation.

34092 **Effect of interphase friction on void fraction prediction.** Nithianandan, C.K.; Shah, N.H. (Babcock and Wilcox Co., Lynchburg, VA). *Transactions of the American Nuclear Society;* **50**: 626-628(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

The RELAP5/MOD1 transient thermal-hydraulic system analysis code has been developed to evaluate pressurized water reactor behavior during accident conditions. Benchmark cases have shown RELAP5/MOD1 to differ from the measured void distribution in certain relevant tests. In an attempt to achieve better agreement, the Wallis annular interphase drag correlation was replaced by the Bharathan-Wallis correlation in the Babcock & Wilcox version of RELAP5/MOD1 (REDBL5). The simulation of two Christensen's subcooled boiling tests using REDBL5 shows better agreement between the measured and calculated void distributions.

34093 **Critical flow through a small break on a large pipe with stratified flow.** Schrock, V.E.; Revankar, S.T.; mannheimer, R.; Wang, C.H. (Univ. of California, Berkeley). *Transactions of the American Nuclear Society;* **50**: 630-631(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

An experimental investigation of critical steam-water two-phase flow through a small break on a horizontal pipe carrying a stratified two-phase flow has been carried out. This flow configuration may occur in small-break light water reactor (LWR) accidents. The critical discharge depends on the effective stagnation state of the fluid entering the break channel and this state is in turn dependent on the orientation of the break (up, down, side) and the proximity of the free surface in the upstream stratified region.

34094 **Two-phase flow regimes in a large-diameter model of a PWR hot leg.** Hashemi, A.; Kim, J.H.; Sursock, J.P. (Science Applications International Corp., Los Altos, CA). *Transactions of the American Nuclear Society;* **50**: 631-633(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

Knowledge of flow regimes in the hot legs and the steam generators of a pressurized water reactor (PWR) is essential in understanding and predicting the overall system thermal-hydraulic response during a small-break loss-of-coolant accident (SBLOCA). Flow regime characterization becomes especially important when natural circulation conditions prevail (low flow rates and high quality) and the potential for breakdown in flow is enhanced. To characterize flow regimes in PWR hot leg geometry, an experimental investigation with 10.2-cm diam glass pipe was carried out. These results showed that valuable information can be obtained from atmospheric pressure air-water flow tests in reactor geometries. This paper describes some preliminary results of 30.5-cm pipe tests.

34095 **Development of a new thermal-hydraulic computer program for LWR rod bundles.** Ho, S.A.; Chelemer, H. (Westinghouse Electric Corp., Pittsburgh, PA). *Transactions of the American Nuclear Society;* **50**: 635-637(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

This paper reports the results of Westinghouse development of the three-dimensional drift-flux model subchannel computer program THETA based on the four-equation drift-flux model derived through the porous media approach. This effort has been carried out to provide a more flexible and accurate tool for advanced fuel concept developments and to enhance the capability of analyzing

fluid flow conditions in fuel rod bundles in which high steam quality and high cross-flow are present. The THETA program has been developed mainly for pressurized water reactor (PWR) applications, but can also be applied to boiling water reactor (BWR) designs. The major features of THETA include: 1) volume porosity concept; 2) turbulent mixing model; 3) unequal phasic velocities and unequal vapor and liquid temperatures; 4) vapor generation model; and 5) transient numerical scheme.

34096 **Plant-computer-based pressurized water reactor primary system thermal-hydraulic model.** Kao, S.P.; Meyer, J.E. (Engineering Planning and Management, Framingham, MA). *Transactions of the American Nuclear Society;* 50: 637-638(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

The motivation for this research is the belief that an on-line information system is essential to enhance reliable operation of a commercial pressurized water reactor. It is further believed that the system should include a physically based analytical model that adequately simulates the dynamics of the plant. Major system codes, such as RETRAN and RELAP, have not been developed for real-time on-line simulation. However, most available real-time simulation codes are very limited in applications. Therefore, the task is to develop a system code that includes both adequate physical models and faster-than-real-time computation capability. The model described has been validated against plant data for single- and two-phase natural circulations. A validation run against a Loss-of-Flow Test Facility (LOFT) small-break loss-of-coolant accident experiment is shown.

34097 **Transient void fraction estimation: a new, simple technique.** Hassan, Y.A. (Babcock and Wilcox Co., Lynchburg, VA). *Transactions of the American Nuclear Society;* 50: 640-641(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

A scaled test facility of the Babcock & Wilcox raised loop nuclear steam supply system referred to as the once-through integral system (OTIS), was used to perform small-break loss-of-coolant accident testing, thereby establishing a data base from which plant predictive system codes could be benchmarked. About 250 instruments were used to record the thermal-hydraulic response of the test facility during the transient, of which 36 were conductivity probes. These probes were designed and installed to determine the liquid/steam interface of the facility hot leg, reactor core vessel, and steam generator components. Thus, to date, the primary function of the probe has been limited to liquid level determination during the course of the transient. A new technique was developed to estimate the local average void fraction using the conductivity probe output signal. The technique uses calibration data as a function of temperature for a liquid immersed probe, and the singular value when immersed in steam to estimate the void fraction in the presence of a two-phase steam and water mixture. Despite the relatively large size and massive geometry of the probe electrode, a favorable agreement between conductivity probe void fraction estimation and that inferred from a differential pressure transmitter was obtained.

34098 **Enhancement of natural circulation by conduction through a vertical redan in LMRs during total loss of heat sink.** Chen, F.F.; Malloy, D.J.; Huebotter, P.R. (Argonne National Lab., IL). *Transactions of the American Nuclear Society;* 50: 641-643(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

A high degree of inherent safety is one of the major features of the latest design concept of advanced liquid metal reactors. A shutdown heat removal system can be designed based on radiative heat transfer among the reactor vessel, guard vessel, and biological shield such that air flow adjacent to the shield provides the ultimate heat sink. Proper sizing can ensure that all of the decay heat can be removed, even in the case of complete loss of normal heat rejection capability. To achieve this goal, the reactor vessel temperature must be high enough to dissipate all the decay heat by means of radiation. A coupled condition is that the temperature at the outlet of the reactor core cannot reach sodium boiling. A most reliable and economical way to satisfy these two criteria is the utilization of a vertical redan. By transmitting heat through the vertical redan from the hot pool into the cold pool, a local natural circulation path will result in the cold pool, which will heat the reactor vessel; simultaneously, a more global natural circulation flow path in the reactor will ensure mass flow rates, which will prevent sodium boiling. To demonstrate this heat removal capability and illustrate the resulting flow pattern inside the vessel, a three-dimensional integral simulation for a generic pool-type reactor has been performed using the multidimensional COMMIX code.

34099 **Steady progress at TMI-2. Past milestones pave the way for recovery teams to retrieve the fuel.** Hess, C.J.; Metzger, S.W. (Idaho National Engineering Lab., Idaho Falls, USA). *International Atomic Energy Agency Bulletin;* 27: No. 4, 16-22(Win 1985).

The accident at Three Mile Island Unit-2 (TMI-2) on 28 March 1979 represents one of the most severe integral tests of commercial nuclear plant safety philosophy and safety systems performance ever encountered in a commercial light-water reactor. The damage to the reactor core and the subsequent release of fission products to the primary coolant system, reactor building, and auxiliary building and systems are the most extensive experienced in any light-water reactor power system. The accident has given the nuclear industry a unique opportunity to advance its understanding of plant behaviour during and after a severe core-damage accident, providing information unobtainable through other severe accident research, development, and test programmes. (Despite the heavy damage to the core and plant, radiation releases to the environment were found to have been very low.) The opportunity to learn from the accident led to the joint establishment of a special programme by the plant's owner, GPU Nuclear, the Electric Power Research Institute (EPRI), the US Nuclear Regulatory Commission (NRC), and the US Department of Energy (DOE). The programme was set up to obtain and analyse data on the accident and its aftermath; establish the accident's cause and consequences; develop new recovery techniques for responding to the unique challenges at TMI; and share the findings and technologies with the commercial nuclear power industry.

34100 **NRC source term assessment for incident response dose projections.** Easley, P.; Pasedag, W. (U.S. Nuclear Regulatory Commission, Washington, DC). pp 6019-6025 of Computer applications in health physics. Kathren, R.L.; Higby, D.P.; McKinney, M.A. Richland, WA; Health Physics Society (1984). (CONF-840202—).

From 17. midyear topical meeting of the Health Physics Society; Pasco, WA, USA (5 Feb 1984).

The NRC provides advice and assistance to licensees and State and local authorities in responding to accidents. The TACT code supports this function by providing source term projections for two situations during early (15 to 60 minutes) accident response: (1) Core/containment damage is indicated, but there are no measured releases. Quantification of a predicted release permits emergency response before people are exposed. With TACT, response personnel can estimate releases based on fuel and cladding conditions, coolant boundary and containment integrity, and mitigative systems operability. For this type of estimate, TACT is intermediate between default assumptions and time-consuming mechanistic codes. (2) A combination of plant status and limited release data are available. For this situation, iterations between predictions based on known conditions which are compared to measured releases gives reasonable confidence in supplemental source term information otherwise unavailable: nuclide mix, releases not monitored, and trending or abrupt changes. The assumptions and models used in TACT, and examples of its use, are given in this paper.

34101 **Exercise Evaluation & Simulation Facility (EESF).** Meitzler, W.D.; Jaske, R.T. (Pacific Northwest Lab., Richland, WA). pp 6027-6033 of Computer applications in health physics. Kathren, R.L.; Higby, D.P.; McKinney, M.A. Richland, WA; Health Physics Society (1984). (CONF-840202—).

From 17. midyear topical meeting of the Health Physics Society; Pasco, WA, USA (5 Feb 1984).

The Exercise Evaluation & Simulation Facility (EESF) is a mini computer based system that will serve as a tool to aid FEMA in the evaluation of radiological emergency plans and preparedness around commercial nuclear power facilities. The EESF integrates the following resources: a meteorological model, dose model, evacuation model, map information, and exercise information into a single system. Thus the user may access these various resources concurrently, and on completion display the results on a color graphic display or hardcopy unit. A unique capability made possible by the integration of these models is the computation of estimated total dose to the population.

25 ENERGY STORAGE

2502 Compressed Gas

34102 (EPRI-EM—4584) Rock cavern linings for compressed-air energy storage. Final report. (Cementation Co. of America, Inc., Tucson, AZ; Acres American, Inc., Buffalo, NY). May 1986. 92p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920311.

Calculations suggest that an average air leakage of 1% per day from a 220-MW underground compressed-air storage plant represents a cumulative energy loss of up to $100,000 per year. This study reviews membrane linings and systems for reducing air loss from permeable rock caverns.

2503 Pumped Hydro

REFER ALSO TO CITATION(S) 33885

2509 Batteries

REFER ALSO TO CITATION(S) 33900, 34182, 34455, 34456

34103 (AD-A—163949/1/XAB) Study of bipolar nickel-cadmium batteries as pulsed load filters. Master's thesis. Chedister, R.W.; Ulmer, J.M. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Nov 1985. 135p. NTIS, PC A07/MF A01.

Bipolar nickel-cadmium batteries were designed, built, and tested for possible use as capacitive filter elements in pulsed-power applications. Electrodes were made by electrochemically impregnating sintered sides of nickel-cell walls. Four-cell batteries were constructed by compressing the electrodes together with Teflon seals. A computer-controlled test circuit charged and discharged the test batteries at frequencies of 1 to 50 H and at depths of discharge of less than 1%. A special test battery was constructed with a removable cadmium electrode for a scanning-electron-microscope study. Battery energy density, effective capacitance, and efficiency were investigated as a function of current load or depth of discharge, cycle rate, and end of discharge voltage. Energy densities of nearly 75 joules per pound were demonstrated. Current loads of up to a 100 C-rate were demonstrated and an average capacitance of 6 farads was achieved. Cadmium electrode morphology was photographed and studied as a function of the charge and discharge cycle life with no crystalline anamolies discovered. Sinter corrosion, nickel-electrode overcharging, and individual cell voltage imbalances were discovered as areas for further study.

34104 (DOE/CE/90038—T1) Evaluation of a new type stable nickel-zinc battery for electric vehicle application. Final report. (Naval Weapons Support Center, Crane, IN (USA)). 26 Jul 1985. Contract AI01-83CE90038. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010895.

This report describes discharge-recharge cycle testing of 14 nickel-zinc storage battery cells of a proprietary design. This testing was to obtain performance data on new types of stabilized nickel-zinc battery cells for possible electric vehicle applications. The test sample cells were manufactured by Electrochimica Corporation (ELCA) in two sizes (15 ampere-hours and 225 ampere-hours) with a total of seven different internal combinations. The cells completed up to 470 cycles when testing was halted due to funding limitations. Near the end of testing, the cells were providing 40% of nominal capacity when discharged to 1.2 volts and 58 to 73% when discharged in two steps to 1.0 volt.

34105 (DOE/ID—10140) Outlook for recycling large and small batteries in the future. Dodds, J.; Goldsberry, J. (EG and G Idaho, Inc., Idaho Falls (USA)). Mar 1986. Contract AC07-76ID01570. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011047.

Although there are many kinds and varieties of batteries, batteries can be subdivided into two basic types, large lead-acid batteries and small disposable batteries. Small cells contain different metals depending upon the configuration. These materials include iron, zinc, nickel, cadmium, manganese, mercury, silver, and potassium. Recycling these materials is not economically attractive. Most small batteries are thrown away and constitute a small fraction of municipal solid waste (perhaps 1/10%). There is no effective energy savings or economic incentive for recycling and, with the exception of Ni-Cad batteries, no significant environmental incentive. Any recycle scheme would require a significant reward (probably financial) to the consumer for returning the scrap battery. Without a reward, recovery is unlikely. Large batteries of the lead-acid type are composed of lead, acid, and plastic. There is an established recycle mechanism for lead-acid batteries which works quite well. The regulations written under the Hazardous and Solid Waste Disposal Amendments (1985) favor more recycling efforts by scrap metal operators. The reason for this is that recycled batteries are exempt from EPA regulation. If batteries are not recycled, any generator disposing of 6 or more batteries per month is required to have a special EPA license or premit. Currently, working against this incentive is a decreasing demand and low market price for lead which affects waste battery salvage.

34106 (LBL—20737) Investigation of a vitreous electrolyte for use in lithium/sulfur cells. Smith, M.L.; McLarnon, F.R.; Cairns, E.J. (Lawrence Berkeley Lab., CA (USA)). Dec 1985. Contract AC03-76SF00098. 110p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE86011192.

Novel Li/S cells, which employed a fast-lithium-ion conducting lithium chloroborate galss as the solid electrolyte, have been built and operated at 400°C. The composition of glass used for this study, 7.3 mol% $(LiCl)_2$, 25.7 mol% Li_2O, and 67.0 mol% B_2O_3, had an ionic conductivity of 2.9 x 10^{-3} $(\Omega^{-1}.cm^{-1})$ ar 400°C, which was somewhat lower than those of other lithium chloroborate glasses, which have shown ionic conductivities as high as 2 x 10^{-2} $(\Omega^{-1}.\ cm^{-1})$. The current-voltage characteristics of these cells were found to be capable of supporting pseudo-steady-state current densities up to 15 mA/cm² for 15-20 hours. A limiting current was found to exist at approximately 23 mA/cm². These cells could be charged and discharged with approximately equal polarization in either direction. However, the accumulation of a crystalline reaction layer on the surface of the electrolyte during discharge caused the cells to fail before the completion of a full charge-discharge cycle. These cells were also used to measure the solubility of lithium (as a polysulfide) in sulfur. The solubility limit was found to occur at 0.04 mol% Li at 400°C.

34107 (PNL—5741) Review of storage battery system cost estimates. Brown, D.R.; Russell, J.A. (Pacific Northwest Labs., Richland, WA (USA)). Apr 1986. Contract AC06-76RL01830. 175p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE86011182.

Cost analyses for zinc bromine, sodium sulfur, and lead acid batteries were reviewed. Zinc bromine and scdium sulfur batteries were selected because of their advanced design nature and the high level of interest in these two technologies. Lead acid batteries were included to establish a baseline representative of a more mature technology.

34108 (SAND—85-2284C) New technique for improving voltage regulation in Li/FeS_2 thermal batteries. Godshall, N.A.; Baldwin, A.R. (Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 10p. (CONF-860688—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010962.

From 32. NASA/US Army international power sources symposium; Cherry Hill, NJ, USA (8 Jun 1986).

Lithiation of the FeS_2 cathode material lowers the voltage of the initial discharge (which is often too high for many applications) and raises the voltage of the battery at the end of discharge (which is often too low due to a second voltage plateau). In the example of the Sandia ten-cell Li(Si)/FeS_2 long-life thermal battery, lithiating the cathode improves the voltage regulation from 12.8 to 0.5% during the initial 5 minutes of discharge and from 38 to 12% over the entire 60 minute discharge time. Batteries employing the new lithiated cathode material were also subjected to dynamic mechanical environments, both before and during electrochemical discharge. No adverse changes in either the electrical or mechanical properties of these batteries was observed, relative to standard composition batteries.

34109 **(SAND—86-2092C) Overview of Sandia's storage battery program.** Clark, R.P.; Grothaus, K.R. (Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 10p. (CONF-860688—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86010956.

From 32. NASA/US Army international power sources symposium; Cherry Hill, NJ, USA (8 Jun 1986).

The primary mission of Sandia National Laboratories is the design and development of the non-nuclear components and systems for nuclear weapons. To a lesser degree, Sandia is also involved in a variety of other programs; such as, energy projects with the Department of Energy, conventional military projects with the Department of Defense, and nuclear waste management and reactor safety with the Nuclear Regulatory Commission. Over the years, Sandia has evolved a considerable expertise in the areas of specialty primary, reserve, and more recently, secondary battery systems. This paper focuses on the status of the storage or secondary battery programs. These programs are divided into those battery systems being developed for energy applications and those being developed for military applications.

34110 **Oxygen depletion and slow crack growth in sodium beta″-alumina solid electrolytes.** Hitchcock, D.C.; De Jonghe, L.C. (Materials and Molecular Research Div., Lawrence Berkeley Lab. and Dept. of Materials Science and Mineral Engineering, Univ. of California, Berkeley, CA 94720). *Journal of the Electrochemical Society;* **133**: No. 1, vp(Jan 1986). Contract AC03-76SF00098.

Slow crack growth in sodium beta″-alumina solid electrolytes resulting from oxygen depletion at the tip of a sodium-filled crack during sodium electrolysis is considered. Extreme depletion of oxygen may lead to a destructive reduction of the electrolyte at the crack tip, thus producing slow crack propagation. The time-dependent and steady-state oxygen concentration profiles in the sodium electrode are calculated and related to a critical flaw size for slow crack propagation.

34111 **Chlorine evolution and reduction processes at oriented single-crystal RuO_2 electrodes.** Hepel, T.; Pollak, F.H.; O'Grady, W.E. (Dept. of Chemistry and Inst. of Colloid and Surface Science, Clarkson Univ., Potsdam, NY 13676). *Journal of the Electrochemical Society;* **133**: No. 1, vp(Jan 1986).

RuO_2 single-crystal electrodes have been used to study the mechanism of the chlorine evolution/reduction reactions. RuO_2 (110) and (101) surfaces show the same anodic Tafel slopes equal to 40 mV/decade. Significant differences in the electrocatalytic behavior of these two surfaces were found for the chlorine reduction reactions. Two cathodic voltammetric peaks at E = 780 and E = 220 mV vs. SCE reference were observed for the RuO_2 (110) electrodes. The peak at E = 780 mV is completely suppressed in case of the RuO_2 (101) electrodes. It is suggested that the natural oxygen sites that are available only on the ideal (110) surfaces provide active centers for the formation of surface $O.Cl^+$ groups that are intermediates in the Krishtalik mechanisms. The cathodic LSV peak at E = 780 mV observed only for the RuO_2 (110) surfaces indicates, then, the reaction path with chloronium intermediates. The influence of the surface ruthenium oxide rearrangement processes on catalytic activity of the electrode and possible changes in the reaction mechanism are discussed in detail.

34112 **Aluminum battery alloys.** Thompson, D.S.; Scott, D.H. (to Dept. of Energy, Washington, DC). US Patent 4,554,131. 19 Nov 1985. Filed date 28 Sep 1984. vp.

PAT-APPL-655486.

Aluminum alloys suitable for use as anode structures in electrochemical cells are disclosed. These alloys include iron levels higher than previously felt possible, due to the presence of controlled amounts of manganese, with possible additions of magnesium and controlled amounts of gallium.

34113 **Secondary battery containing zinc electrode with modified separator and method.** Poa, D. S.; Yao, N. P. (to The US of America as represented by the United States Department of Energy). US Patent 4,544,616. 1 Oct 1985. Filed date 16 Feb 1984. vp.

PAT-APPL-580982.

A battery containing a zinc electrode with a porous separator between the anode and cathode. The separator is a microporous substrate carrying therewith an organic solvent of benzene, toluene or xylene with a tertiary organic amine therein, wherein the tertiary amine has three carbon chains each containing from six to eight carbon atoms. The separator reduces the rate of zinc dentrite growth in the separator during battery operation prolonging battery life by preventing short circuits. A method of making the separator is also disclosed.

34114 **Glass electrolyte composition.** Kucera, G. H.; Roche, M. F. (to The United States of America as represented by the United States Department of Energy). US Patent 4,544,614. 1 Oct 1985. Filed date 8 Jan 1985. vp.

PAT-APPL-689735.

An ionically conductive glass is disclosed for use as electrolyte in a high temperature electrochemical cell, particularly a cell with sodium anode and sulfur cathode. The glass includes the constituents Na_2O, ZrO_2; Al_2O_3 and SiO_2 in selected proportions to be a single phase solid solution substantially free of crystalline regions and undissolved constituents. Other advantageous properties are on ionic conductivity in excess of 2×10^{-3} $(ohm\text{-}cm)^{-1}$ at 300° C. and a glass transition temperature in excess of 500° C.

34115 **Zinc electrode cycle-life performance in alkaline electrolytes having reduced zinc species solubility.** Nichols, J.T.; McLarnon, F.R.; Cairns, E.J. (Lawrence Berkeley Lab., CA). *Chemical Engineering Communications;* **37**: 355-379(1985). Contract AC03-76SF00098.

Electrolytes having 3.5 M hydroxide-ion concentration were tested in 1.35 Ah Zn/NiOOH cells to evaluate their ability to reduce the extent of zinc species migration and slow the rate of cell capacity decline. Alkaline-fluoride and alkaline-borate electrolytes, in which ZnO solubility is approximately 25% of that in standard 7.4 M KOH electrolyte, exhibited 0.09-0.14%/cycle zinc-electrode area loss, which may be compared to a value of 0.46%/cycle observed in standard electrolyte. In addition, no zinc penetration of the separator occurred in cells that employed alkaline-fluoride and alkaline-borate electrolytes, even when zinc-electrode overpotentials reached 290 mV at the end of charge. Less than 2% of the zinc remaining after cycling was electrochemically inactive. 30 references, 17 figures, 4 tables.

34116 **High-temperature lithium batteries.** Cairns, E.J. (Lawrence Berkeley Lab., CA). pp 179-204 of Lithium battery technology. Venkatasetty, H.V. (eds.). New York, NY; John Wiley & Sons, Inc. (1984). Contract AC03-76SF00098.

Lithium cells and batteries generally offer very high specific energy (over 100 Wh/kg in most cases), a distinct advantage over the types of cells. Rechargeable lithium cells that operate at ambient temperature have been very difficult to develop because of the problems associated with the repeated deposition of lithium in a compact, porous, active form (no dendrites or permanent passivation) and because of the scarcity of lithium-compatible positive electrode reactants that undergo reversible electrode reactions (in lithium-compatible electrolytes). In addition, high specific power has been difficult to achieve in rechargeable ambient-temperature lithium cells because of the low ionic conductivity of the available nonaqueous electrolytes. It has been found that a number of these

problems can be circumvented by the use of rechargeable lithium cells that operate at elevated temperatures (300-500°C). The advantages gained by the use of high-temperature lithium cells are discussed.

34117 **Molten-salt battery cells with sulfur or metal sulfide electrodes.** Selman, J.R. (Illinois Institute of Technology, Chicago). pp 219-234 of Sulfur electrode. New York, NY; Academic Press, Inc. (1983). Contract AC02-77ER04445.

A brief review of applications of sulfur and metal sulfide electrodes in advanced battery cells having a molten-salt mixture as the electrolyte is presented. Unfortunately, a systematic treatise on high-temperature batteries is at present not available. However, the reader will find in this section sufficient references to permit a further exploration. The battery cells reviewed here make use of lithium, or lithium alloys, and calcium, or calcium alloys, as negative electrode material and of sulfur and metal sulfides such as FeS, FeS_2, NiS_2, CoS_2, Cu_2S, and TiS_2, or mixtures of these, as positive electrode material. All have a molten-halide mixture as the electrolyte. 66 references, 6 figures, 4 tables.

34118 **(NP-tr—6901439) Process for preparing nickel coatings in conducting, porous bodies, especially for battery electrodes.** Faber, P. (Rheinisch-Westfaelisches Elektrizitaetswerk A.G., Essen (Germany, F.R.)). [1986]. Translation of Federal Republic of Germany, German Patent Office public disclosure document No. 1 809 323, November 16, 1968. 9p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86901439.

This patent pertains to a process for preparing nickel coatings in conducting, porous bodies, especially for battery electrodes. In the process, a nickel layer is first galvanically applied on the body, characterized in that the body with its galvanic nickel layer is heated to a temperature above 200°C on the inside and a temperature below 200°C in peripheral zones by ohmic heat in a carbon monoxide atmosphere, whereby nickel is introduced as a coating from the nickel layer into the body. An electrical current is sent through the body for the ohmic heating in the direction of a longitudinal axis or a thickness axis. The body is heated under pressure. The carbon monoxide atmosphere is pressed through the body. Up to 50% hydrogen is mixed to the carbon monoxide atmosphere. Up to 10% nickel tetracarbonyl is mixed to the carbon monoxide atmosphere.

29 ENERGY PLANNING AND POLICY

2901 Energy Analysis And Modeling

34119 **(CONF-8604185—1) Overview of IDES: an integrated demand and energy supply equilibrium model.** Macal, C.M. (Argonne National Lab., IL (USA)). 1986. Contract W-31-109-ENG-38. 35p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86010509.

From 2. symposium on analytic techniques for energy, natural resources, and environmental planning; Philadelphia, PA, USA (3 Apr 1986).

The IDES (Integrated Demand and Energy Supply) Model is a price-quantity equilibrium model - similar to the Long-Term Energy Analysis Package (LEAP) - for projecting energy quantities and prices over a time horizon of up to 30 years. The model integrates resource production activities, petroleum refining, electricity generation, fuel processing, and energy demand. Unlike most energy equilibrium models, IDES is designed to be small enough to run on a microcomputer, as well as on a mainframe computer. This paper describes the model's design objectives, mathematical formulation, iterative solution algorithm, and computer implementation. A recent application to a developing country is also discussed.

2902 Economics And Sociology

REFER ALSO TO CITATION(S) 33696, 33718, 34147, 34148, 34149, 34150, 34160, 34234, 34732

34120 **(PB—86-161494/XAB) Energy and urban form. Final report.** (Kingston, Reynolds, Thom and Allardice Ltd., Auckland (New Zealand)). Oct 1985. 23p. NTIS, PC A03/MF A01.

Many factors - social and cultural, historical, topographical and functional - influence urban form. Their relationship with the energy resources available to a community at any particular time, and the uses to which those resources are put, are an important aspect of their combined influence. From this, a direct relationship may be drawn between energy and urban form. Little study has been made of it in New Zealand and the report sets out to make an appraisal of that relationship. From an earlier, more limited brief, the scope of the report has been extended to embrace a wider urban view of the subject. The opening section briefly discusses the sectoral split of urban energy, discussing direct and indirect energy use in this context. The report then moves on to its general pattern, identifying research in New Zealand (and some overseas) relevant to particular aspects of urban development.

34121 **(PB—86-928500/XAB) Economic and Energy Indicators. Weekly report.** (Central Intelligence Agency, Washington, DC (USA)). 1986. vp. NTIS.

Subscription.

The EEI provides up-to-date information on changes since 1977 in economic and energy activities of major countries. It consists of tables only. They depict (a) economic indicators (industrial production, unemployment, consumer price inflation, and exchange rate trends) for the Big Seven developed countries (United States, Japan, West Germany, France, United Kingdom, Italy, and Canada); (b) foreign trade and foreign trade prices for the Big Seven; and (c) monthly average prices for selected agricultural products and industrial materials. The energy indicators include tables on petroleum consumption, production, and imports for the Big Seven. A table and chart depict the movement of OPEC average crude oil sales prices since 1973.

2903 Environment, Health, And Safety

REFER ALSO TO CITATION(S) 33593, 33595, 33596, 33597, 33598, 33599, 33602, 33603, 33615, 33617, 33619, 33621, 33622, 33703, 33862, 33880, 33957, 34145, 34146, 34158, 34164, 34734, 34736, 34762, 34804, 34812, 34813, 34827, 34850, 34900

34122 **(AD-A—163693/5/XAB) Controlling nonpoint pollution in Virginia's urbanizing areas: an institutional perspective. Final report.** Wells, G.M. (Army Military Personnel Center, Alexandria, VA (USA)). 20 Jan 1986. 170p. NTIS, PC A08/MF A01.

This paper evaluates the effectiveness of the institutional framework of the Commonwealth of Virginia in the implementation and enforcement of nonpoint source (NPS) pollution-control measures in the state's urbanizing areas. The institutional framework is developed primarily around the existing governmental framework. The federal, state and local roles are examined in terms of the relevant legislative and executive NPS control activities already taking place. The judicial function is considered in terms of constitutional guarantees of protection of private property and the potential for liability stemming from the implementation of structural and nonstructural best management practices (BMP's). Three generic categories of BMP's are evaluated in light of this institutional environment: on-site BMP's, off-site BMP's, and nonstructural BMP's. Where they are relevant, various sub-categories of the institutional environment are examined: mechanisms and responsibility for financing and maintenance, managing future urban growth and mediating interjurisdictional arrangements. The introduction and first four chapters develop this material and the final chapter is an analysis of the existing state programs (the Erosion and Sediment Control Law and the State Water Control Board's voluntary Urban NPS Control and Abatement Program). The product of this analy-

sis is the conclusion that both state programs are weak due to a lack of adequate state oversight.

34123 **(AD-A—163889/9/XAB) Installation restoration program. Phase 1. Records search, Air Force Plant 44, Tucson, Arizona. Final report.** (Science Applications International Corp., McLean, VA (USA)). Oct 1985. 230p. NTIS, PC A11/MF A01.

This report provides an introduction, description, and environmental setting of Air Force Plant 44, Tucson, Arizona. It reviews past and present practices of wastewater treatment, landfills, waste oil pits, chrome and die yard pits, disposal and spill sites. A total of 11 sites were ranked using the HARM (Hazard Assessment Rating Methodology) rating system.

34124 (CONF-850339—, pp 149-160) **Sensitive habitats, threatened and endangered species.** Woodhouse, C.D. (Santa Barbara Museum of Natural History, CA). Dec 1985. NTIS, PC A12/MF A01. File Number DE86007984.

From California offshore petroleum conference; Long Beach, CA, USA (26 Mar 1985).

The various steps taken to protect the many species of marine birds and mammals of central and southern California have been successful in certain cases, but late 20th century development will take a toll if careful planning and thought do not go into the problems of multiple uses of habitats and the preservation of wildlife. Biologically sensitive habitats belong to one of four categories: ecological reserves, marine life refuges, reserves, and areas of special biological significance, but both the federal and the state government have their classifications of land use and criteria for determining potential extinction of species. The author identifies 22 species needing protective legislation, and cites eight areas of human activity that currently impact coastal waters, one of which is mineral resource exploration and development. 18 references, 2 figures, 3 tables.

34125 (FWS/OBS—80(40.21), pp 8-25) **Congressional dilemma - design making in the face of uncertainty.** Bierbaum, R.M. (Office of Technology Assessment, Washington, DC). Oct 1985. NTIS, PC A06/MF A01. File Number TI86900511. (CONF-8408184—Pt.1).

From 114. annual meeting of the American Fisheries Society; Ithaca, NY, USA (12 Aug 1984).

Five key uncertainties are especially relevant to Congressional decisions about transported air pollutants. These include controversies about the extent and location of current damages, future damages (whether they are cumulative and/or irreversible), geographic origins of observed levels of pollution, the effectiveness of emissions reductions for decreasing observed levels of transported pollutants, and whether the ongoing research program will provide significant new results. There are four major approaches currently available for Congressional action on transported air pollutants: mandating emissions reductions to further control the sources of transported pollutants; liming lakes and streams to mitigate some of the effects of acid deposition; modifying the Federal acid deposition research program to provide more timely guidance for Congressional decisions; and modifying existing sections of the Clean Air Act to enable EPA, states to more effectively address some aspects of transported air pollutants. Most legislative proposals in the 98th Congress (12 out of 19) have concentrated on the first approach. Mandating further emissions reductions would require the Congress to make a number of interrelated choices. These include decisions about which pollutant emissions to reduce, from what source regions, by how much, and over what time period. Congress would also need to choose specific policy mechanisms to implement the reductions, allocate their costs, and address undesired secondary consequences of emissions reductions.

34126 **(GAO/RCED—86-68FS) Environment, safety and health. Status of Department of Energy's Implementation of 1985 Initiatives.** (General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div.). Mar 1986. 12p. US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877. File Number TI86901392.

Fact Sheet for the Ranking Minority Member, Subcommittee on Energy, Nuclear Proliferation, and Government Processes, Committee on Governmental Affairs, US Senate.

This report reviews the following initiatives of the Secretary of Energy regarding DOE's environmental, safety, and health programs: (1) reorganizing the ES and H activities at DOE headquarters; (2) revising ES and H orders; (3) conducting a major environmental survey of conditions at DOE sites; (4) carrying out major technical safety appraisals of conditions at DOE's nuclear facilities; (5) revising ES and H information reporting and racking systems; (6) increasing environmental guidance; and (7) enhancing the professional development of ES and H staff. (ACR)

34127 **(GAO/RCED—86-98FS) Superfund. Status of superfund management information systems.** (General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div.). Feb 1986. 15p. US General Accounting Office, Box 6015, Gaithersburg, MD 20877. File Number TI86901397.

Fact sheet for the Chairman, Subcommittee on Commerce, Transportation, and Tourism, Committee on Energy and Commerce, House of Representatives.

This report discusses the status of EPA's efforts to improve its management information systems for the Superfund enforcement and remedial programs. (ACR)

34128 **(PB—86-150174/XAB) Reducing hazardous waste generation: an evaluation and a call for action. Final report.** (National Research Council, Washington, DC (USA)). 1985. 86p. NTIS, PC A05/MF A01.

The report examines key institutional, or nontechnical, factors that affect the generation of industrial waste and discusses the public policy approaches that could encourage industries to reduce generation. Industrial waste reduction programs can be expected to occur through a series of overlapping phases as the programs become increasingly costly and sophisticated. Public policies need to be dynamic and flexible to adapt to the changing circumstances. At this time, most waste reduction efforts in U.S. industry are in their early stages and many relatively simple and inexpensive opportunities exist for reducing generation of hazardous waste. Nonregulatory approaches, such as educational programs and information dissemination, are required to encourage waste reduction. Increasing costs of land disposal are also an important impetus to undertaking waste reduction programs. In the future, as industries need to use more sophisticated waste reduction methods, research and development assistance in meeting capital costs will be needed. Finally, the technological, political, and economic limit of waste reduction will be approached; a program of risk assessment and management will be needed to define this limit.

34129 **(PB—86-156478/XAB) Hazardous-waste-management practices in the United States.** Dial, C.J. (Environmental Protection Agency, Cincinnati, OH (USA). Hazardous Waste Engineering Research Lab.). Jan 1986. 33p. (EPA/600/D—86/027). NTIS, PC A03/MF A01.

The paper was prepared for presentation at a joint US/Spain Seminar on Hazardous Waste Management to be held in Madrid, Spain, on May 19-22, 1986. Hazardous-waste quantities produced in the United States and how they are handled/disposed of are presented. Major environmental legislation is discussed. Organization and description of research activities of the Hazardous Waste Engineering Research Laboratory are provided.

34130 **(PB—86-158946/XAB) Acute Hazardous-Events Data Base. Interim report (Final).** Cummings-Saxton, J.; Lechner, L.; Ratick, S.J.; Buckley, P.; Corwin, T.K. (Industrial Economics, Inc., Cambridge, MA (USA)). Dec 1985. 209p. NTIS, PC A10/MF A01.

This document contains summaries of records of 3,121 accidental releases of hazardous substances. Because of sampling, these records represent a larger population of 6,928 events. One section describes the background and methodology. Another discusses the 468 events associated with the reported 4,717 injuries and 138 deaths. Other sections summarize the events as a whole, with attention to end effects, causes and quantities. A section considers large-

scale atmospheric releases, assessing similarities to the Bhopol accident. Appendices contain the data coding procedures; summary data base profiles; a list of chemicals reportedly released; summary statistics for events with reported deaths of injuries and for events with spills or vapor releases, but not fires or explosions; and a brief listing of all events with reported deaths or injuries.

34131 **(PB—86-159522/XAB) Handbook for waterborne transportation of hazardous materials and wastes.** Burr, C.A.; O'Dell, R. (Mississippi-Alabama Sea Grant Consortium, Ocean Springs, MS (USA)). Dec 1985. 62p. (MASGP—85-018). NTIS, PC A04/MF A01.

Production, storage, transport, and disposal of hazardous substances are concerns which are rapidly rising to the forefront of national attention. Federal statutes and regulations governing the production and handling of hazardous materials have attained a level of volume and complexity which has few, if any, equal. Manufacturers and transporters have the responsibility to understand and comply with hazardous materials so as to avoid accidents. Increased public interest and pressures to find adequate storage places for hazardous wastes in a shrinking world have caused additional demands for state regulation as well. Local governments bear the burden of primary responsibility for immediate reaction to emergency spills of hazardous substances. This handbook is concerned with the federal laws as well as the state laws of Mississippi and Alabama concerning hazardous materials and wastes transport, primarily that which travels by water. It is intended to serve as a reference guide to aid local and administrative personnel and elected officials to gain insight into such a complex field of law. Due to the volume of enactments and regulations, the handbook strives only to set forth the black-letter law and provide information to enable the user to make contacts necessary to seek out more information regarding interpretation of the law and the specific functions of those who deal with it.

2904 Natural Resources

REFER ALSO TO CITATION(S) 34124, 34863, 34865

34132 **(AD-A—163455/9/XAB) Mineral deposits and mineral potential of the Randsburg Wash Test Range. Summary report, 1 January-31 July 1983.** Austin, Carl F.; Durbin, William F.; AtienzaMoore; Featherstone; Bjornstad, Steven C. (Naval Weapons Center, China Lake, CA (USA)). Dec 1983. 89p. (NWC-TP—6465). NTIS, PC A05/MF A01.

This report presents the results of a literature search and an appropriate field survey of all reported claims and prospects on the Randsburg Wash Test Range (RWTR) China Lake, California and in the area of the RWTR access road. The field survey was of sufficient scope to ensure the validity of the literature and to obtain data on minerals of current high interest. The mineral commodities evaluated include gold, silver, iron, mercury, uranium, semiprecious gems, building stone, gravel, volcanic ash, geothermal, and water resources. Each of the resources is described and the location mapped. Assay results and a detailed water analysis are included.

34133 **(GAO/RCED—86-31) Resource protection. Mississippi Valley Canada Geese: flyway management obstacles.** (General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div.). Feb 1986. 79p. US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877. File Number TI86901387.

Report to Congressional requesters.

The US Fish and Wildlife Service's legislation, regulations, and various documents and statistics were examined regarding federal migratory bird and Canada goose protection and management. The service's legal authority to take action to require states to limit harvests of Canada geese was also reviewed. (ACR)

34134 **(GAO/RCED—86-48) Public lands. Interior should ensure against abuses from hardrock mining.** (General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div.). Mar 1986. 50p. General Accounting Office, Box 6015, Gaithersburg, MD 20877. File Number TI86901389.

Report to The Secretary of the Interior.

This report describes how effectively the Bureau of Land Management (BLM) is regulating mining activities conducted under the Mining Law of 1872, as amended. We found that because BLM does not require its state offices to screen mining claim data at the time the claims are recorded, some claims are recorded without sufficient information to determine their location, and claims located on federal lands after they are closed to minerals exploration and development are not being identified and invalidated. Furthermore, despite legislative requirements for reclamation, some BLM lands are not being reclaimed, and BLM does not require most miners to post bonds covering the costs of reclamation.

34135 **(GAO/RCED—86-89FS) Resource management. Information on the coastal zone management program.** (General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div.). Feb 1986. 15p. General Accounting Office, Box 6015, Gaithersburg, MD 20877. File Number TI86901396.

Fact sheet for the Chairman, Committee on Merchant Marine and Fisheries, House of Representatives.

This report discusses (1) federal program objectives, (2) the status of state programs, (3) the results of previous program studies, (4) program benefits cited by state officials, and (5) concerns raised by federal and state officials, including the results of an interview with NOAA's Assistant Administrator for Ocean Services and Coastal Zone Management.

34136 **(GAO/RCED—86-103) Water resources. Bureau of Reclamation's Bonneville Unit: future repayment arrangements.** (General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div.). Mar 1986. 11p. U.S. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877. File Number TI86901384.

Report to the Honorable Howard M. Metzenbaum, United States Senate.

GAO is convinced that: the Bureau of Reclamation's use of the Water Supply Act of 1958 to defer a portion of municipal and industrial (M and I) costs of the Bonneville Unit was illegal, the Bureau's use of ad valorem (percentage of value) tax revenues from property owners to increase the Bonneville Unit's M and I customers repayment obligation under the 1965 contract was improper, and the Department of Energy Organization Act 1977 requires congressional approval of the modified cost allocation of the Bonneville Unit initiated by the Bureau in 1984.

34137 **(PB—86-154085/XAB) Effects of the 1978 Katangese rebellion on the world cobalt market. Working paper.** (Charles River Associates, Inc., Cambridge, MA (USA)). Dec 1982. 74p. NTIS, PC A04/MF A01.

Cobalt has a variety of applications, the most important being superalloys (principally used in jet engines), permanent magnets, and chemicals. Production is concentrated in a small number of countries, most notably Zaire, and is generally a byproduct of other mining and refining operations. Total U.S. consumption has ranged from 20 million pounds in 1978 to 12 million pounds in 1981, but U.S. mine production is zero. The situation began to change in 1978, when demand began to increase very rapidly in response to a relatively strong world economy and a boom in the aerospace industry. As a result, a dealer market for cobalt developed, and the dealer price (as opposed to the producer price, at which Zairean and some other cobalt is sold) began to creep upward.

34138 **(PB—86-155504/XAB) Potential for the development and use of new alloys to reduce the consumption of chromium, cobalt, and manganese for critical applications. Draft final report.** Tien, J.K.; Jarrett, R.N. (Columbia Univ., New York (USA). Center for Strategic Materials). 26 Sep 1983. 100p. NTIS, PC A05/MF A01.

Cobalt, chromium, and manganese are import-reliant materials that are critical to many industries in the United States and are strategic to the country's defense. High-temperature, corrosion-resistant superalloys are the major consumers of cobalt and high-purity chromium; stainless steels are the major consumers of fer-

rochromium; and, certain structural steels are significant consumers of manganese. These patterns of reliance will remain despite the existence of ready substitutes and potential substitutes.

34139 **Coastal Zone '85. Proceedings of the Fourth Symposium on Coastal and Ocean Management. Volume 1.** Magoon, O.T.; Converse, H.; Miner, D.; Clark, D.; Tobin, L.T. (eds.). New York, NY; American Society of Civil Engineers (1985). 1317p. (CONF-850749—Vol.1). American Society of Civil Engineers, 345 E. 47th St., New York, NY 10017-2398. File Number TI86010385. Contract FG01-85FE60677.

From 4. symposium on coastal and ocean management; Baltimore, MD, USA (30 Jul 1985).

The conference was dedicated to the presentation of the current state of the art in coastal zone management. Topics included in this volume are erosion planning and monitoring, oil spills, policy/planning approaches, regulations, port planning, wetlands protection, fisheries, waste disposal, dune restoration, citizen action, and shoreline management. (ACR)

34140 **Coastal Zone '85. Proceedings of the Fourth Symposium on Coastal and Ocean Management. Volume 2.** Magoon, O.T.; Converse, H.; Miner, D.; Clark, D.; Tobin, L.T. (eds.). New York, NY; American Society of Civil Engineers (1985). 1399p. (CONF-850749—Vol.2). American Society of Civil Engineers, 345 E. 47th St., New York, NY 10017-2398. File Number TI86010386. Contract FG01-85FE60677.

From 4. symposium on coastal and ocean management; Baltimore, MD, USA (30 Jul 1985).

The conference was dedicated to the presentation of the current state of the art in coastal zone management. Topics included in this volume are oil and gas planning, fisheries management, sedimentation, international case studies, shoreline stabilization, urban waterfronts, ecosystems analysis, modelling, sea level rise, water quality, and citizen involvement. (ACR)

2905 Research, Development, Demonstration, And Commercialization

REFER ALSO TO CITATION(S) 33697, 34149, 34171, 34854

34141 **(CONF-860729—4) Methodology for economic evaluation of technologies in the early research and development stages.** Williams, K.A. (Oak Ridge National Lab., TN (USA)). 1986. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86008971.

From Summer computer simulation conference; Reno, NV, USA (28 Jul 1986).

A systematic methodology has been developed for building, combining, and exercising a set of specially devised performance, design, and cost models in a form suitable for economic assessments in the presence of major technological uncertainties. This document describes the development and utilization of the methodology that incorporates model development and multivariable uncertainty analysis for the projection of potentially competitive, full-scale performance and costs of a first-of-a-kind process or systems technology still in the early research and development stages. By Monte Carlo simulation, a spectrum or distribution of the resulting performance or life-cycle cost figure-of-merit value, along with its associated probabilities, is calculated. The appropriate format for development of the user's modeling system, which includes the capability to reoptimize the proposed systems for each set of process inputs considered, along with the required stepwise approach for selection of values and ranges of the major system variables (inputs), is presented. The basic principles of this methodology can be applied to many new technologies - including those relevant to the Strategic Defense Initiative (SDI). Interpretation of the probabilistic output data is also discussed. Such data can be useful to the experimentalists, as well as to those decision makers who must recommend or decide (1) whether a particular process should be further developed or (2) which of several competing technologies should be selected for continued support. Recent experiences with this methodology in the assessment of advanced energy technologies for the US Department of Energy are discussed. Potential applications to the SDI are also suggested. 9 refs., 5 figs., 1 tab.

34142 **(PB—86-158920/XAB) Oil replacement analysis, Phase 1. Selection of technologies. Final report.** (Gibbs and Hill, Inc., New York (USA)). Nov 1984. 293p. NTIS, PC A13/MF A01.

The Office of Technology Assessment (OTA) of the U.S. Congress has initiated a study to analyze various proactive and reactive options that can minimize the adverse impacts to the U.S. economy as a result of a 3 to 4 million barrels per day (MMbbl/d) cutoff in U.S. oil imports. As part of the project, Gibbs & Hill, Inc. (G&H) has undertaken a two-phase study on rapid deployment of selected oil-replacement technologies (ORT's). The two phases of the G&H study are: Phase I - Selection of ORT's, Phase II - Evaluation of selected ORT's.

34143 **(PB—86-158938/XAB) Oil-replacement analysis, Phase 2. Evaluation of selected technologies. Final report.** (Gibbs and Hill, Inc., New York (USA)). Nov 1984. 153p. NTIS, PC A08/MF A01.

The Office of Technology Assessment (OTA) of the U.S. Congress has initiated a study to evaluate the ability of various oil-replacement technologies (ORT's), under a rapid deployment scenario, to mitigate the effects of a sudden cutoff of 3 to 4 million barrels per day (MMbbl/d) of oil imports. Gibbs & Hill (G&H) has completed Phase I of the study in which the most promising ORT's were selected for further evaluation. In the Phase II study, presented herein, G&H has evaluated the selected ORT's with regard to oil-replacement potential and rate of replacement. The maximum relacement potential is 2.7 MMbbl/d within 5 years based on summing the potential of each technology after imposing independent constraint limitations. When these constraints are mutually applied, the oil-replacement potential of the selected technologies is likely to be in the area of 1.6 MMbbl/d.

34144 **(PB—86-902100/XAB) Government research and development summaries: chemical, electrical, mechanical, nuclear, TE, TI and solar project briefs. Monthly report.** (Interagency Advanced Power Group, Fort Belvoir, VA (USA)). 1986. vp. NTIS.

Subscription.

The Government Research and Development Summaries now available from NTIS are project Briefs prepared by the Interagency Advanced Power Group. They describe the status of all programs in the fields of advanced power research, development and engineering. Members of the Interagency Advanced Power Group (IAPG) are the U.S. Army, Navy, and Air Force, U.S. Department of Energy and the National Aeronautics and Space Administration (NASA). Their Cooperative effort monitors government-funded research and development producing project briefs in the following five categories. Chemical, Electrical, Mechanical, Nuclear, and Solar. Each project brief contains title; project description; contract number, period, probable completion date and funding; principal investigator name and telephone number; contractor name and address; directing agency and index terms. Subscribers who receive any of the project brief packages will also recieve the semi-annual IAPG Project Briefs By Field of Interest, and the Annual Completed or Cancelled Compilation and cumulative Annual Project Brief Subject Index which are combined into a single publication.

34145 **(PNL—5750-Pt.3) Pacific Northwest Laboratory annual report for 1985 to the DOE Office of Energy Research. Part 3. Atmospheric sciences.** Elderkin, C.E. (Pacific Northwest Labs., Richland, WA (USA)). Feb 1986. Contract AC06-76RL01830. 91p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86010488.

The goals of atmospheric research at Pacific Northwest Laboratory (PNL) are to describe and predict the nature and fate of atmospheric contaminants and to develop an understanding of the atmospheric processes contributing to their distribution on local, regional, and continental scales. In 1985, this research has examined the transport and diffusion of atmospheric contaminants in areas of complex terrain, summarized the field studies and analyses of dry

deposition and resuspension conducted in past years, and begun participation in a large, multilaboratory program to assess the precipitation scavenging processes important to the transformation and wet deposition of chemicals composing "acid rain." The description of atmospheric research at PNL is organized in terms of the following study areas: Atmospheric Studies in Complex Terrain; Dispersion, Deposition, and Resuspension of Atmospheric Contaminants; and Processing of Emissions by Clouds and Precipitation (PRECP).

2906 Nuclear Energy

REFER ALSO TO CITATION(S) 33753, 33773, 34015, 34126, 34813, 34817, 34819

34146 **(ENEA-RT/PROT—82-24) Mathematical approach to a general study on exclusion from the Paris convention of installation handling small quantities of nuclear substances.** Breuer, F.; Quadrini, E.; Trenta, G. (ENEA, Rome (Italy). Direzione Sicurezza Nucleare e Protezione Sanitaria). Sep 1982. 98p. NTIS (US Sales Only), PC A05/MF A01. File Number DE86901367.

The object was to achieve a mathematical formulation for a numerical definition of the concept of "small quantities" of nuclear substances in connection with the exclusion limits from the application of the Paris Convention on third party liability in the field of nuclear energy. The formulation would be applicable to almost all radionuclides with the exception of noble radioactive gases.

34147 **(INIS-mf—10106) Collection of papers 1983.** (Vyzkumny Ustav Palivoenergetickeho Komplexu, Prague (Czechoslovakia)). 1984. 39p. (In Czech and Slovak). NTIS (US Sales Only), PC A03/MF A01. File Number DE86702200.

The collection contains 21 papers of which three were input in INIS. Topics covered include: electrification problems and nuclear energy; development of the Czechoslovak nuclear power complex; development of the economics of the fuel and energy base and of its relationship to the development of Czechoslovak economy.

34148 (INIS-mf—10106, pp 15-21) **Electrification problems.** Kadlec, J. 1984. (In Czech). NTIS (US Sales Only), PC A03/MF A01. File Number DE86702200.

In Collection of papers 1983.

The long-term forecast assessing the role of electric power in the power and fuel balance of Czechoslovakia shows that the highest rate of growth should be expected in the field of nuclear energy and in the consumption of electric power. The development of nuclear power is giving rise to a number of problems such as the rapid increase of capital costs, the load factor reduction of coal fired power plants, etc. The problem areas are defined to which attention should be paid in the development of nuclear power. The use of electric power for heating and for heating utility water favourably affects the form of the diagram of daily consumption. Analyses show that the growth of consumption of electric power may be threatened by problems in the distribution network.

34149 (INIS-mf—10106, pp 53-71) **Development of the Czechoslovak nUclear power complex.** Rajci, T.; Skvarka, P.; Rousek, J.; Svec, P. 1984. (In Slovak). NTIS (US Sales Only), PC A03/MF A01. File Number DE86702200.

In Collection of papers 1983.

The research tasks are briefly described following from the construction of the nuclear energy complex in Czechoslovakia, and the contribution of the newly established Research Institute of Fuel and Energy Complex to their solution. The Institute's main task is research at the level of forecasting and conceptional planning. The results are given of a comparison of several variants of the construction of nuclear power plants with WWER 1000 reactors with regard to costs and demands on personnel. The strategy is described of the three-campaign fuel replacement which allows a 0.5% increase in mean burn-up.

34150 (INIS-mf—10106, pp 140-150) **Development of the economics of the fuel and energy base and of its relationship to the development of Czechoslovak economy.** Hachran, S. 1984. (In Czech). NTIS (US Sales Only), PC A03/MF A01. File Number DE86702200.

In Collection of papers 1983.

The most important knowledge is presented obtained from the draft prognosis of the long-term development of the economics of the fuel and energy base of Czechoslovakia up to the year 2000 and in some aspects, including the generation of electric power, up to the year 2030. The proportion is assessed of electric power and heat generated in nuclear power plants and in heating plants. The forecast is presented of the extraction of fuels and the generation of electric power, their import and export and their investment and overall economic demand. The evaluation of the forecast indicates the necessity of reducing the fuel and power demand of the Czechoslovak national economy.

34151 **(Juel-Spez—332) Nuclear energy from the viewpoint of adolescents. Content analysis of essays of Bavarian high school students.** Peters, H.P. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Programmgruppe Technik und Gesellschaft). Sep 1985. 67p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE86752046.

It was found that in the discussion about nuclear energy the aspect 'health and safety risks' plays the major role. Nuclear energy in this dimension is judged ambivalent by proponents of nuclear energy and clearly negative by opponents. Suprisingly, proponents and opponents agree on the advantages of nuclear energy in securing long-term energy supply. Even a lot of proponents of nuclear energy were not convinced that a safe disposal of nuclear waste is technically possible. With respect to fossil and renewable energy sources the dimensions 'security of supply' and 'environmental impacts' were the most crucial ones. Both energy sources are judged very negatively in both dimensions. The students who favour the use of nuclear energy were found to rate fossil and renewable energy sources more negatively than those who opposed nuclear energy. (orig./HP).

34152 **(NUREG—0540-Vol.8-No.3) Title list of documents made publicly available, March 1-31, 1986. Volume 8, No. 3.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Technical Information and Document Control). May 1986. 464p. NTIS, PC A20/MF A01 - GPO. File Number TI86901412.

The Title List of Documents Made Publicly Available is a monthly publication. It contains descriptions of the information received and generated by the US Nuclear Regulatory Commission (NRC). This information includes (1) docketed material associated with civilian nuclear power plants and other uses of radioactive materials and (2) nondocketed material received and generated by NRC pertinent to its role as a regulatory agency. As used here, docketed does not refer to Court dockets; it refers to the system by which NRC maintains its regulatory records. This series of documents is indexed by a Personal Author Index, a Corporate Source Index, and a Report Number Index.

34153 **(NUREG—0750-Vol.23-No.3) Nuclear Regulatory Commission issuances. Volume 23, No. 3.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Technical Information and Document Control). Mar 1986. 127p. NTIS, PC A07/MF A01 - GPO. File Number TI86901443.

This report includes the issuances received during the specified period from the Commission (CLI), the Atomic Safety and Licensing Appeal Boards (ALAB), the Atomic Safety and Licensing Boards (LBP), and the Directors' Decisions (DD).

34154 **(NUREG/BR—0081-Rev.1) Nuclear Regulatory Commission directory of high-technology 8(a) firms. Revision 1.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Small and Disadvantaged Business Utilization/Civil Rights). May 1986. 117p. NTIS, PC A06/MF A01 - GPO. File Number TI86901441.

An overview is given for each of the high-technology small business firms qualifying under section 8(a) of the Small Business Act for consideration under Minority Business Development Plans. Each overview gives detailed profiles of relevant technical classification data, client contacts, and information on the professional personnel of each firm. In addition, the directory contains information about average gross receipts and facilities, including testing capabilities and computer availability. (LEW)

34155 **Nuclear waste primer. A handbook for citizens.** New York, NY; Nick Lyons Books (1985). 96p. (NP—6901362). L.W.V.E.T., Nick Lyons Books, 31 W. 21st St., New York, NY 10010. File Number TI86901362.

The aim of this publication is to offer the nonexpert a concise, balanced introduction to nuclear waste. It outlines the dimensions of the problem, discussing the types and quantities of waste. It then defines the sources, types, and hazards of radiation and reviews the history, major laws, and current status of both high level and low level waste management. Finally, it describes how citizens can plug into nuclear waste decision-making and identifies selected information sources.

34156 **Nuclear power in the Midwest.** Chicago, IL; Energy Resources Center, University of Illinois (1984). 251p. (CONF-8410315—).

From 12. annual Illinois energy conference; Chicago, IL, USA (31 Oct 1984).

The Twelfth Annual Illinois Energy Conference, held in Chicago, Illinois, October 1984 was sponsored by the Energy Resources Center, University of Illinois at Chicago in cooperation with the U.S. Department of Energy, the Illinois Department of Energy and Natural Resources, the Illinois Energy Resources Commission, and the Illinois Commerce Commission. The theme for the conference was "Nuclear Power in the Midwest." The topic of Nuclear Power is particularly appropriate in view of the fact that the State of Illinois, as well as the Midwest region, has made a major commitment to the use of this option for electric power generation. This is evidenced by the fact that some twenty-three of the eighty-six currently licensed nuclear reactors in the United States are located in the Midwest region. Illinois alone contains ten licensed nuclear reactors with four other nuclear plants either under construction or waiting for an operating license. In rated capacity of electric power generated by nuclear reactors, the region is capable of producing 21.5% of the national total of 70,000 MWe. The problems surrounding nuclear power involve complex technologies, environmental and public health concerns, economic and legal factors as well as numerous other policy questions. The goal of the 12th Annual Illinois Energy Conference was to review these issues in order to educate the public and to assist government policy makers in making rational judgements regarding the use and development of the nuclear power option.

2908 Waste Heat Utilization

REFER ALSO TO CITATION(S) 34228

34157 **(DOE/CE/40716—T1) Market potential for small scale (15 kW to 500 kW) cogeneration systems.** (Mueller Associates, Inc., Baltimore, MD (USA)). 27 Nov 1985. Contract AC01-84CE40716. 68p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86008934.

As electric utilities continuously adjust their rates to reasonable reflect changing costs, small scale cogeneration will be found to be beneficial overall as a result of shaving high cost utility system peaks with a more energy and cost effective technology. In those locations where electric utility rates are high, in general, small scale cogeneration can also be used in a baseload mode as well. Particularly susceptive to small scale cogeneration are those areas suffering or about to suffer the "nuclear rate shock" of a new nuclear facility coming on stream. By all accounts, small scale cogeneration will become a major industry. The industry will be cost effective and conserve energy compared to existing central power plants.

34158 **(PB—86-156221/XAB) Analysis of the costs and cost effectiveness of allowing SO_2 emission credits for cogeneration systems. Final report.** (Radian Corp., Research Triangle Park, NC (USA)). Dec 1985. 64p. NTIS, PC A04/MF A01.

This document discusses the results of a cost analysis performed to assess the reasonableness of emission credits for cogeneration facilities under new source performance standards limiting SO_2 emissions from industrial-commercial-institutional steam-generating units. Emission credits would allow a cogeneration system to achieve a lower percent reduction in emissions or to meet a higher emission limit in proportion to the increased overall efficiency achieved by the cogeneration system. The analysis examined two common types of cogeneration, steam generator-based and combined-cycle systems, and analyzed the incremental cost effectiveness of not providing emission credits versus providing emission credits for two regulatory alternatives: standards based on the use of low-sulfur fuels and standards requiring a percent reduction in SO_2 emissions.

2910 Conservation

REFER ALSO TO CITATION(S) 34194, 34195, 34199, 34209, 34219, 34230

2920 Supply, Demand, And Forecasting

REFER ALSO TO CITATION(S) 33694, 33695, 33716, 34120, 34121, 34142, 34143, 34148, 34149, 34150

34159 **(EPRI-EM—4525-Vol.1) Residential end-use load-shape estimation. Volume 1. Methodology and results of statistical disaggregation from whole-house metered loads. Final report.** Usoro, P.B.; Schick, I.C. (Scientific Systems, Inc., Cambridge, MA (USA)). May 1986. 175p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920280.

End-use load shapes are important for the development of improved load forecasting techniques, analysis of load management and costing/rate making. A methodology for estimating end-use load shapes using hourly whole-house metered load data, household demographic survey data, and weather data (temperature) is presented. Although the focus of the project was on the residential sector, the techniques developed can also be applied to the industrial and commercial sectors. In the present approach, the coupling of lifestyle and weather in load demand is clearly modeled. Weather-independent load is modeled with Fourier-like terms (sine and cosine functions) and dummy variables, and weather-dependent load is represented by a thermodynamics-based nonlinear dynamic model exhibiting heat build-up effect, thermostat set-point variation, and appliance saturation. Automatic data pre-processing is incorporated to eliminate anomalous data using pattern recognition techniques. The overall methodology provides an effective means for end-use load shape modeling. In particular, the effect of weather on electricity demand, which concerns power system forecasters and planners, is accurately represented.

34160 **(PB—86-161486/XAB) Economic cost of energy nonsupply. Final report.** Sharp, B.M.H.; Baker, W.R.; Bodger, P.S. (Canterbury Univ., Christchurch (New Zealand). Dept. of Electrical and Electronic Engineering). Sep 1985. 66p. NTIS, PC A04/MF A01.

A comprehensive evaluation of the costs and benefits of alternative investment and supply strategies requires estimates of the economic impact of alternative levels of energy nonsupply. Estimates of the economic cost of nonsupply can contribute to solving the problem of allocating limited energy, and to evaluating investment proposals for augmenting supply and improving supply reliability. Nonsupply is a component of an energy planning methodology rather than a complete analytical method. Four classes of economic models - macroeconomic, general equilibrium, input-output, and cost-benefit - are identified and their utility in nonsupply analysis is assessed.

2930 Policy, Legislation, And Regulation

REFER ALSO TO CITATION(S) 34125, 34147, 34148, 34149, 34150, 34156, 34595

34161 (CONF-860531—2) National energy planning for developing countries. Wilbanks, T.J. (Oak Ridge National Lab., TN (USA)). 1986. Contract AC05-84OR21400. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86011073.

From Annual meeting of the Association of American Geographers; Minneapolis, MN, USA (4 May 1986).

This paper is a summary of what has been learned from the experience with national energy planning in developing countries. It considers lessons learned about the roles of data, analysis, and modeling in this enterprise, because of the connections between these components and our common interest in research to advance the state of the art; but it concludes that the most important needs at this time are institutional rather than analytical, which suggests a somewhat different set of priorities for scholarship related to national energy planning in the developing world.

34162 Overview of the physical, chemical, and thermodynamic properties of fossil fuel liquids program sponsored by the Office of Fossil Energy, US Department of Energy. McGurl, G.V.; McKinstry, W.E. (Pittsburgh Energy Technology Center, PA). pp 213-214 of IUPAC conference on chemical thermodynamics. Hamilton, Ontario; McMaster University (1984). (CONF-840807—).

From Conference on chemical thermodynamics and 39. calorimetry conference; Hamilton, Canada (13 Aug 1984).

Research on the physical, chemical and thermodynamic properties of fossil fuel liquids, their intermediates and their derivatives is pivotal to the development of fossil energy technologies. There is general agreement that the knowledge of these properties is an extremely important factor in the design, demonstration and ultimate success of conversion facilities. This importance has been conclusively documented by the recently completed pilot and demonstration plant program of the Office of Fossil Energy. This program highlighted the substantive link between the scientific understanding of fossil fuel liquids and the engineering design of facilities. Thus, long-term scientific research on the physical, chemical, and thermodynamic properties of fossil fuel liquids is an essential part of a balanced fossil energy R & D program that seeks as the central thrust of its mission to develop an adequate scientific and engineering knowledge base for fossil fuel technologies to be commercialized by the private sector. The strategy of the physical, chemical, and thermodynamic properties of synfuels program is based on the assumption that many universities have a capability to measure accurately such properties for synfuels and that NIPER and PETC have substantial capabilities to perform such measurements in synfuel characterization, particularly for residuum-containing streams.

2940 Fossil Fuels

REFER ALSO TO CITATION(S) 33650, 33651, 33659, 33660, 33661, 33662, 33663, 33664, 33665, 33666, 33691, 33692, 33693, 33694, 33695, 33696, 33697, 33699, 33700, 33702, 33703, 33704, 33706, 33716, 33718, 33718, 33723, 34162, 34164

2950 Hydrogen And Synthetic Fuels

REFER ALSO TO CITATION(S) 34162

34163 (PB—86-151545/XAB) Producer gas - analysis of costs of fuel, operation, and capital employed for different methods of generating electrical power. Lubbe, W.F. (National Timber Research Inst., Pretoria (South Africa)). Aug 1984. 21p. NTIS, PC A04/MF A01.

The report consists of a number of cost calculations and comparisons between the different methods of generating electric power. Both the report and appendix were meant for producer-gas project-evaluation meetings. The cost figures can still be used as a base for future calculations provided that a percentage be added for the inflation rate.

34164 Monitoring performance of environmental control technology. Sheesley, D.C.; Inguva, R.; Taylor, J. New York, NY; American Institute of Chemical Engineers (1985). 36p. (CONF-841121—). American Institute of Chemical Engineers, 345 East 47th Street, New York, NY 10017. Contract AS20-83LC10988.

From AIChE annual meeting; San Francisco, CA, USA (25 Nov 1984).

Existing methods for monitoring the data on synthetic fuel by products in fossil fuel technologies are reviewed. The results of applying traditional statistics for product concentrations, regression analysis, and nonparametric methods are discussed. It is shown that the data may not always be amenable to standard statistical analysis. Alternate techniques using Bayesian methods are suggested for improved analysis. The relevance of this work to monitoring performance of environmental control technology is discussed.

2960 Electric Power

REFER ALSO TO CITATION(S) 33956, 33957, 33968, 34163, 34174, 34175

34165 (AD-A—163456/7/XAB) Mobile tactical electric-power-system operational analysis. Final report. (BDM Corp., Vienna, VA (USA)). Nov 1985. 81p. (BDM/W—85-0546-TR). NTIS, PC A05/MF A01.

The objective of this report is to document a preliminary military operational analysis which identifies the critical parameters and factors necessary for detailed assessments of Army mobile tactical electric-power requirements and for hardware-effectiveness analyses of mobile tactical electric-power systems. The report includes a detailed description of a methodology to estimate a unit's power requirements, which in turn defines the needed generator output. Further, the report addresses data base requirements for implementation of the developed analysis. The US Army's significant tactical mobile electric-power needs are presently being met by a large number and wide variety of electric-power generators. Changes in electric-power consumption are anticipated as a result of ongoing efforts to modernize the force. In addition, there is a requirement to reduce the logistics burdens associated with tactical power production. For these reasons, the Army is assessing the adequacy of current tactical power sources, and is exploring opportunities to improve their utilization. To support this program, extensive combat operations and hardware effectiveness analyses must be made.

34166 (AD-A—163603/4/XAB) Development of 3- and 5-kW fuel cell power plants. Final technical report, October 1979-July 1985. Abens, S.; Farooque, M. (Energy Research Corp., Danbury, CT (USA)). 12 Dec 1985. 119p. NTIS, PC A06/MF A01.

Phosphoric-acid fuel-cell power plants for use as tactical utility power sources were developed. The power plants operate on 58% methanol-42% water fuel. Two fully automatic 3kW units were built, tested, and delivered. Thermal efficiency was 23% with ac and 26% with dc output. A brassboard 3-kW power plant operating on neat methanol was also constructed, tested, and delivered. The methanol-water premix fuel-cell power plant operates on a 1:1.3 molar mixture of methanol and water which is converted in a steam reformer, operating at 300 C, to hydrogen-rich product gas. The fuel cell uses 60 to 65% of the hydrogen to produce dc electricity, and the balance is combusted in a burner to supply heat required for the endothermic reforming process. The phosphoric-acid-fuel cell stack is air-cooled and operates at a temperature of 190C. The fuel cell power plant is capable of delivering either regulated dc or ac electrical power through the use of interchangeable power conditioners. A microprocessor-based controller provides event sequencing and system control during startup, shutdown, and operation of the power plant.

34167 (PB—86-154630/XAB) Toshiba review international edition, No. 153, Autumn 1985. (Toshibe Corp., Tokyo (Japan). Principal Office). 1985. 60p. NTIS, PC A04/MF A01.

Contents include: World's Largest-Capacity Tandem-Type Pump-Turbines Installed at the Wivenhoe Pumped-Storage Power Station; The Uruguaian Frequency Converter Station Interconnecting Brazilian and Argentine av Systems; Large-Capacity Scherbius Systems - Slip Power Recovery Control; Helium Magnetic-Refrigerator for Cooling Superconducting Devices; Advanced Substation and Telecontrol Systems of Beijing-Qinhuanagdao Line, China; Local Process Operator Console and Digital Control System; A Compact Dual-Channel NNSS Position-Fixing System; Ultrasound Diagnostic Linear/Convex Scanner Eliminating Blind Regions; 1M bit CMOS EPROM; Aluminum Nitride Substrates Having High Thermal Conductivity.

34168 **(PNL—5866) Stratified random sampling plan for an irrigation customer telephone survey.** Johnston, J.W.; Davis, L.J. (Pacific Northwest Labs., Richland, WA (USA)). May 1986. Contract AC06-76RL01830. 64p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86011542.

This report describes the procedures used to design and select a sample for a telephone survey of individuals who use electricity in irrigating agricultural cropland in the Pacific Northwest. The survey is intended to gather information on the irrigated agricultural sector that will be useful for conservation assessment, load forecasting, rate design, and other regional power planning activities.

34169 **(PNL-SA—13767) Energy conservation strategies and the use of market research in time of system surplus.** Johnson, D.R.; Fang, J.M.; Ivey, D.L. (Pacific Northwest Labs., Richland, WA (USA)). Feb 1986. Contract AC06-76RL01830. 9p. (CONF-8604109—5). NTIS, PC A02. File Number DE86011130.

From Pacific Gas and Electric (PG&E) energy expo; Oakland, CA, USA (29 Apr 1986).

Energy Conservation programs have become recognized as effective tools for utilities interested in deferring the need for new generating units. However, many utilities currently find themselves in circumstances in which generating capacity exceeds demand. This paper explores appropriate conservation strategies under these circumstances. The general approach is to build the capability to quickly acquire conservation resources in the future when they are needed, using market segmentation and market research. A strategy for some market segments involves maintaining and reinforcing the likelihood of future investment in energy conservation. A separate strategy involves cultivating other market segments to increase the likelihood of future investment.

34170 **Understanding the environment for today's capacity expansion decisions: implications for technology design.** Chapel, S.W.; Clark, C.E.; Abrahamson, P.G. (Electric Power Research Institute, Palo Alto, CA). *Transactions of the American Nuclear Society;* **50**: 6(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

Utility capacity planning has grown increasingly difficult as market conditions have changed in recent years. The problems caused by unexpectedly low demand, unexpectedly high costs, and front-end loading of capital cost can be at least partially solved by making smaller investments, i.e., by building many small plants rather than a few large plants. This paper explores the implications of this observation for the nuclear power industry. Quantifying the benefits of modularity, realizing the benefits of modularity, and potential obstacles are discussed.

34171 **Power system stability direction for future research.** Iveson, R.H. (Electric Power Research Institute, Palo Alto, CA 94304). pp 271-275 of Proceedings of the international symposium on power system stability. Ames, IA; University of Iowa (1985). (CONF-8505169—).

From International symposium on power systems stability; Ames, IA, USA (13 May 1985).

In summary, the paper proposes the research needs for a sequenced improvement of system stability analysis capabilities leading eventually to on-line, real-time control of events. The paper proposes a structure to analyze the research needs and, using that structure, states the problem, examines possible solutions, sets goals, and a timetable to achieve those goals. A forecast of the effort required is provided as well as an estimate of the probability of success.

2980 Consumption And Utilization

REFER ALSO TO CITATION(S) 33693, 34159

2990 Unconventional Sources And Power Generation

REFER ALSO TO CITATION(S) 34890

34172 **(CONF-840676—Summ.) Report of the 1984 international roundtable on renewable energy. Summary.** (Renewable Energy Inst., Alexandria, VA (USA)). 1984. Contract FG02-84CH10194. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010405.

From Renewable energy technologies symposium and international exposition; Anaheim, CA, USA (5 Jun 1984).

In June 1984, twenty-one senior officials from twelve countries gathered in California for an unusual meeting. The subject was renewable energy, but unlike most programs on this topic, the emphasis was on policy rather than technology. The meeting addressed the question of what other countries might learn from California experiences. Purpose of the Roundtable was to explore the types of policies that have proven effective in California for helping develop renewable energy; to learn about the experience US electric utilities have had in using renewable energy; and to observe renewable energy technologies in operation through site visits.

34173 **(PB—86-160348/XAB) Factors and equations to estimate forest biomass in the North Central region. Forest Service research paper (Final).** Smith, W.B. (Forest Service, St. Paul, MN (USA). North Central Forest Experiment Station). 1985. 10p. (FSRP-NC—268). NTIS, PC A02/MF A01.

Green weight of wood and bark can be affected by moisture content. Average moisture content percentages and green-weight conversion factors are presented for 42 tree species groups. Equations are also presented to compute average green weight of tops and limbs as well as stumps.

30 DIRECT ENERGY CONVERSION

3001 Mhd Generators

34174 **(AD-A—163636/4/XAB) Fuel-processing system for a 5-kW methanol fuel-cell power unit. Final report, 20 September 1984-20 September 1985.** Steinfeld, G. (Energy Research Corp., Danbury, CT (USA)). 27 Nov 1985. 107p. NTIS, PC A06/MF A01.

This report documents the development and design of a 5-kW neat methanol reformer for phosphoric-acid-fuel cell power plants. The reformer design was based on utilizing burner exhaust as the source of water required for reforming. This approach was arrived at after evaluation of several system options. A developmental unit was tested, and test data is documented indicating that all design objectives were met except for start-up time.

34175 **(AD-A—163781/8/XAB) Development of partial oxidizer/reformer for PAFC power plants. Final technical report, 22 April 1983-22 October 1985.** Christner, L.G. (Energy Research Corp., Danbury, CT (USA)). 15 Nov 1985. 85p. NTIS, PC A05/MF A01.

This report documents the development of a methanol partial-oxidation reformer designed to provide hydrogen to a 3-kW phosphoric acid fuel cell powerplant. The partial-oxidation reformer operates on neat methanol and utilizes the fuel-cell-cathode exhaust stream as the oxidant.

34176 (DOE/ID/01745—T9) Mountain States Energy Division. Quarterly technical progress report, January 1-March 31, 1986. (Mountain States Energy, Inc., Butte, MT (USA)). 1986. Contract AC07-78ID01745. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010758.

This quarterly technical progress report presents the tasks accomplished at the Component Development and Integration Facility during the second quarter of FY86. Areas of technical progress included: Coal system development; test bay modification; seed system development; combustion efficiency measurement; independent test activities; coal-fired combustor (CFC) nozzle fabrication; diffuser window materials testing; CFC support; 1A channel refurbishment; instrument characterization and error analysis; and test operations and results. 7 figs.

34177 (DOE/MC/19314—2046) Differential optical absorption techniques for diagnostics of fossil fuel combustion. Final report, October 1982-March 1986. (Mississippi State Univ., Mississippi State (USA). MHD Energy Center). Mar 1986. Contract AC21-82MC19314. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010084.

The application of differential optical absorption (DOA) techniques for the in-situ determination of the chemical composition of fossil fuel combustion streams is investigated. Absorption spectra of relevant molecular species and the temperature and pressure effects on DOA-determined spectral characteristics of these species will be determined and catalogued. A system will be configured, assembled, and tested.

3005 Fuel Cells

REFER ALSO TO CITATION(S) 34166, 34252

34178 (DOE/ID/12495—T8) Application of fuel cells to chlorine caustic membrane technology. Monthly status report, April 1-30, 1986. (Physical Sciences, Inc., Andover, MA (USA)). 19 May 1986. Contract FC07-84ID12495. 12p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86010681.

From the membrane screening to date, one experimental membrane, designated E-1, exhibits slightly poorer conductivity than A-1, but slightly better sodium ion transport and similar electroosmotic water flux than A-1. Another experimental membrane, C-1, has exhibited similar performance characteristics to those of A-1.

34179 (DOE/MC/21185—2042) Electrochemical investigation of lithium/potassium carbonate eutectic for application in modeling the molten carbonate fuel cell cathode. Final progress report. McCoy, L.; Schuman, M. (Rockwell International Corp., Canoga Park, CA (USA). Rocketdyne Div.). Apr 1986. Contract AC21-84MC21185. 97p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86001087.

A program involving the design, construction, and operation of a high-temperature cell equipped with a rotating gold disk electrode has been carried out with the objective of identifying and quantifying the principal oxide species present in molten $LiKCO_3$ electrolytes using electrochemical measurements. The dependence of the current on electrode rotational speed at 750 to 800°C indicates that the data are typical of the convective/diffusive transport of an electroactive species from the bulk electrolyte. The reverse is true at 650°C, where the current increases with an increasing voltage sweep rate but is little affected by the speed of electrode rotation. In the latter case, a current by chemical reaction occurring within the electrode boundary layer is indicated. The linear current-voltage increase observed at the lower temperature in the presence of about 20 mol % O_2 has not been accounted for. Graphical analysis of the data taken with air and C_2 sparged electrolyte at 750 and 800°C indicates the electroactive species to be the superoxide ion. Computer studies of the same data using regression analysis methodology indicate that the current may instead arise from the reduction of the peroxide ion concurrently with other electroactive material derived from secondary catalytic reactions or electrolyte impurities. Additional data will be required to support either conclusion with certainty. Detailed studies of the electrochemistry of the $LiKCO_3$ electrolyte over a broader range of temperatures and sparge gas compositions are recommended as a means of providing a second basis for identifying the electrode reactions. 29 refs., 47 figs., 3 tabs.

34180 (ENEA-RT/FARE-IMM—83-1) Consideration on the prospective concerning fuel cell plant application. Di Mario, F.; Scibona, G.; Vellone, R.; Violante, V.; Botta, G.; Taschini, A. (ENEA, Casaccia (Italy). Dipartimento Fonti Alternative e Risparmio Energetico; Ente Nazionale per l'Energia Elettrica, Milano (Italy). Centro di Ricerca Elettrica). Oct 1983. 34p. (In Italian). NTIS (US Sales Only), PC A03. File Number DE86901406.

The fuel cell, basically a device which converts the energy of a fuel directly to electricity by an electrochemical process, appears to have numerous attributes (high efficiency low environmental emissions, modular construction) which could make its utilization in the power generation extremely attractive in the not-too-distant future. This work is a preliminary evaluation of fuel cell plants and their application potential in the Italian energy system.

34181 Process for making structure for a MCFC. Pasco, W.D.; Arendt, R.H. (to Dept. of Energy, Washington, DC). US Patent 4,581,303. 8 Apr 1986. Filed date 3 Apr 1985. vp.

A process is described of making a porous carbonate, containing structure for use in a molten carbonate fuel cell, comprising preparaing a suitable porous structure having therein a metal salt selected from the alkali metals and the alkaline earth metals or mixtures thereof wherein at least a portion of the salt is a monobasic organic acid salt, and converting the monobasic acid salt to the carbonate in situ.

34182 Rapidly refuelable fuel cell. Joy, R. W. (to The United States of America as represented by the United States Department of Energy). US Patent 4,560,626. 24 Dec 1985. Filed date 20 Sep 1982. vp.

PAT-APPL-420053.

A rapidly refuelable dual cell of an electrochemical type wherein a single anode cooperates with two cathodes and wherein the anode has a fixed position and the cathodes are urged toward opposite faces of the anodes at constant and uniform force. The associated cathodes are automatically retractable to permit the consumed anode remains to be removed from the housing and a new anode inserted between the two cathodes.

34183 Short protection device for stack of electrolytic cells. Katz, M.; Schroll, C.R. (to Dept. of Energy). US Patent 4,548,874. 22 Oct 1985. Filed date 29 Nov 1984. vp.

PAT-APPL-676340.

Electrical short protection is provided in an electrolytic cell stack by the combination of a thin, nonporous ceramic shield and a noble metal foil disposed on opposite sides of the sealing medium in a gas manifold gasket. The thin ceramic shield, such as alumina, is placed between the porous gasket and the cell stack face at the margins of the negative end plate to the most negative cells to impede ion current flow. The noble metal foil, for instance gold, is electrically coupled to the negative potential of the stack to collect positive ions at a harmless location away from the stack face. Consequently, corrosion products from the stack structure deposit on the foil rather than on the stack face to eliminate electrical shorting of cells at the negative end of the stack.

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

34184 (ANL/CNSV-TM—178) Current trends in seasonal ice storage. Gorski, A.J. (Argonne National Lab., IL (USA)). May 1986. Contract W-31-109-ENG-38. 40p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86011677.

This document is a compilation of modern research projects focused upon the use of naturally grown winter ice for summer cooling applications. Unlike older methods of ice-based cooling, in which ice was cut from rivers and lakes and transported to insulated icehouses, modern techniques grow ice directly in storage con-

tainers - by means of heat pipes, snow machines, and water sprays - at the site of application. This modern adaptation of an old idea was reinvented independently at several laboratories in the United States and Canada. Applications range from air conditioning and food storage to desalinization.

34185 **(DOE/CE—0155) National Awards Program for Energy Innovation, 1985. Project descriptions.** (USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC). May 1986. 266p. NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE86011406.

The projects present a diversity of approaches, both large scale and small, to eliminating waste, saving money, and finding new uses for alternate sources of energy. Project descriptions have been arranged according to the following end user categories: agriculture, industries, small businesses, housing, transportation, financing, outreach, utilities, education, public buildings, communities, and government. (DLC)

3201 Buildings

34186 **(AD-A—164326/1/XAB) Automated design of real-time, microprocessor-based controllers. Volume 1. Master's thesis.** Heacock, R.L. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Sep 1985. 179p. (AFIT/GCS/ENG—85S-1-VOL-1). NTIS, PC A09/MF A01.

This thesis determined the conceptual and implementation limitations in the use of the Control System Design Language and its timing analysis program and realization libraries for the automated design of real-time, microprocessor-based controllers. Changes were made to the language syntax and timing analysis program to permit a more accurate analysis of the timing requirements of a controller. Conceptual and implementation errors in the primitives of the original realization volume were addressed and solutions presented. A new realization volume using the memory-mapped input/output architecture of the Motorola 6800 microprocessor was developed to determine any bias toward device oriented input/output in the existing primitive designs. A partial Intel 8088 volume was constructed to investigate the applicability of the primitive designs in a segmented memory processor. A volume builder program was developed to aid in the construction and formatting of the realization volumes. A major design effort using the Field Interface Device of an Energy Monitoring and Control System as an example was performed to thoroughly exercise the timing analysis program.

34187 **(EPRI-EM—4423) Lighting handbook for utilities. Final report.** Khosla, N.K.; Bachner, J.P. (Enviro-Management and Research, Inc., Springfield, VA (USA)). Apr 1986. 207p. Research Reports Center, Box 50490 Palo Alto, CA 94303. File Number TI86920281.

This comprehensive handbook provides up-to-date information on energy-efficient lighting systems suitable for use by commercial and industrial customers. In helping customers select the most appropriate lighting systems for their needs, utility representatives should find this reference useful.

34188 **(EPRI-EM—4523-Vol.1) EPRI simplified program for residential energy (ESPRE). Volume 1. Review of energy analysis methods and model development. Final report.** Merriam, R.L.; Rancatore, R.J. (Little (Arthur D.), Inc., Cambridge, MA (USA)). May 1986. 82p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920293.

A review of the theory and implementations of simplified residential building energy analysis methods is carried out. Strengths and weaknesses and the areas of application of the methods are identified. Two programmable calculator programs (ADM-3 and the NBS TI-59 procedure) are evaluated along with four microcomputer based calculative methods (CIRA, HOTCAN, MICROPAS, SEA). The review, which was carried out in 1983, indicates the relationships between the various procedures. A new microcomputer based simulation method is developed. The program, ESPRE (EPRI Simplified Program for Residential Energy), which is implemented in MS-DOS FORTRAN, reads TMY weather data to carry out hourly simulations of thermal loads and energy use in a one or two conditioned space residential building. Typical residential structures including an attic or cathedral ceiling and one of three foundation types (slab, crawlspace, or basement) can be modeled. The equipment simulation models handle the variation in hourly performance characteristics with temperature and part load operation degradation. The program is tested using metered hourly energy and temperature data for several unoccupied houses.

34189 **(LBL—17940) Multizone infiltration studies at Lawrence Berkeley Laboratory.** Feustel, H.E. (Lawrence Berkeley Lab., CA (USA)). Mar 1986. Contract AC03-76SF00098. 8p. (EEB-EPB—86-05; CONF-850804—4). NTIS, PC A02/MF A01; GPO Dep. File Number DE86011311.

From World congress on heating, ventilating and air conditioning--international exhibition; Copenhagen, Denmark (25 Aug 1985).

The simplified infiltration models now used to simulate incoming and outgoing air flows for single-zone structures, such as one-family houses, are not suitable for a high percentage of existing houses, whose floorplans classify them as multizone structures. Multizone infiltration requires extensive and complex information about the flow characteristics and pressure distribution inside the building, and thus has been too difficult to develop and to validate. Our purpose has been to devise a simplified multizone infiltration model. To this end, we have simplified the description of the airflow distribution in a building by relying on lumped parameters. Further simulation runs are necessary to confirm that these parameters are sufficient for describing infiltration in buildings. This paper describes these parameters and the considerations involved in the development of our multizone infiltration model.

34190 **(LBL—18395) AC pressurization: a technique for measuring leakage area in residential buildings.** Modera, M.P.; Sherman, M.H. (Lawrence Berkeley Lab., CA (USA)). Mar 1986. Contract AC03-76SF00098. 24p. (EEB-EPB—86-04; CONF-850606—18). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011310.

From American Society of Heating, Refrigerating and Air-Conditioning Engineers' semiannual meeting; Honolulu, HI, USA (23 Jun 1985).

This report presents a new technique for measuring the leakage area of residential buildings. This technique, called AC pressurization, is designed to overcome most of the shortcomings of fan pressurization, the conventional technique for measuring leakage area. The fan pressurization technique (often performed using a blower door) has several known deficiencies: (1) the pressures it exerts on the building envelope are significantly higher than those experienced under natural conditions, thereby requiring extrapolation outside of the measurement range to calculate the leakage area; (2) it cannot make real-time leakage area measurements; and (3) the large volumes of air displaced by the fan can cause inconveniences such as large indoor temperature changes. AC pressurization, which induces sinusoidal pressure differences across the building envelope, can make real-time leakage measurements at low pressures without inducing large flows through the building envelope. The AC pressurization apparatus and analytical technique, as well as the laboratory measurements that determined the specifications for the field device are described herein. Field measurements of leakage area obtained with our prototype AC pressurization device are compared with those obtained by fan pressurization tests of six single family residences.

34191 **(LBL—20236) Energy signature monitor (ESM). Lessons learned.** Szydlowski, R.F. (Lawrence Berkeley Lab., CA (USA)). Mar 1986. Contract AC03-76SF00098. 14p. (EEB-EPB—86-02; CONF-8510218—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011306.

From Field data acquisition for building and equipment energy-use monitoring national workshop; Dallas, TX, USA (16 Oct 1985).

The Lawrence Berkeley Laboratory, DOE, has developed the Energy Signature Monitor (ESM), an innovative data acquisition system which addresses the data acquisition and analysis re-

quirements of test programs which involve monitoring of large samples of buildings. Information about typical number of sensors and accuracy requirements for such large monitoring projects was incorporated into the development of the ESM in order to meet the needs of most researchers without adding unnecessary, and expensive, features. The ESM hardware includes a microprocessor controlled data acquisition program, sixteen analog channels, two pulse count channels, an RS232 computer interface, and a removable EPROM-based data storage module. In conjunction with the hardware a complete data management software package, written to operate on a microcomputer, was developed to facilitate analysis of the recorded data. A total of 23 ESMs have been built to date, all of which are being used in a field monitoring study currently being conducted by Lawrence Berkeley Laboratory. Lessons learned during development, field use, and ESM design technology transfer to the private sector are reported.

34192 **(ORNL/CON—203) Electricity use for residential space heating: comparison of the Princeton Scorekeeping Method with end-use load data.** Hirst, E.; Goeltz, R. (Oak Ridge National Lab., TN (USA)). Apr 1986. Contract AC05-84OR21400. 42p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86011295.

The Princeton Scorekeeping Method (PRISM) is perhaps the best known and most widely used method to adjust residential use data for differences in winter severity. Purpose of this report is to compare PRISM results with submetered data from homes in Hood River, Oregon. The data used for this analysis are being collected as part of the Hood River Conservation Project (HRCP), a major residential retrofit demonstration project. HRCP data include whole-house and space-heating electricity uses, recorded at 15-minute intervals. Weather data are also recorded at 15-minute intervals, at the Hood River Experiment Station. The usual NOAA weather data were also available for this station; NOAA data on daily temperatures were used in this project. Finally, results of a detailed on-site home interview with these households are also available for analysis. We compared PRISM estimates of total annual electricity use and of space heating electricity use with annual aggregates of the load data. These comparisons were conducted with two sets of the Hood River submetered homes. The first set consisted of 185 homes that used more than 2000 kWh for space heating during the 1984/85 year. The second set, a subset of the first, included 71 homes that used more than 4000 kWh/year for space heating, did not have portable electric heaters, and did not extensively use their air conditioners.

34193 **(ORNL/Sub—83-43337/2) Absorption heat pump simulation and studies: a modular computer simulation of absorption systems. Final report.** Grossman, G.; Michelson, E. (Technion-Israel Inst. of Tech., Haifa). Apr 1986. Contract AC05-84OR21400. 83p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86011206.

A computer simulation program for absorption systems has been developed in a flexible and modular form, which makes it possible to simulate various configurations with different working fluids. The user supply input containing information about given flow rates and temperatures, as well as characteristics of the various subunits of the system. In addition, the user must convey to the computer an image of the cycle in question. The program calculates the temperature, composition, flow rate, and pressure at each state point of the system and the heat quantities at each unit, from which the coefficient of performance may be determined. The program has been tested on single- and double-stage absorption heat pumps and heat transformers with lithium bromide-water and water-ammonia as the working fluids. Results have been compared with experimental data from tests of a lithium bromide-water heat transformer, giving good agreement.

34194 **(PB—86-151412/XAB) Pennyland project: executive summary. Final report.** Chapman, J.; Lowe, R.; Everett, R. (Open Univ., Milton Keynes (UK). Energy Research Group). 1985. 63p. (ERG—054). NTIS, PC A05/MF A01.

The Pennyland project has involved the design, layout, construction and monitoring of an estate of 177 low-energy houses in Milton Keynes. The project started in 1976 when there was relatively little knowledge about the performance of well-insulated houses of a passive solar design in the U.K.

34195 **(PB—86-151420/XAB) Pennyland project. Final report.** Lowe, R.; Chapman, J.; Everett, R. (Open Univ., Milton Keynes (UK). Energy Research Group). 1985. 423p. (ERG—053). NTIS, PC A15/MF A01.

The Pennyland project has involved the design, layout, construction and monitoring of an estate of 177 low-energy houses in Milton Keynes. The project started in 1976 when there was relatively little knowledge about the performance of well-insulated houses of a passive solar design in the U.K.

34196 **(PB—86-157146/XAB) Status of water heating technology: 1985.** DeWerth, D.W. (American Gas Association Labs., Cleveland, OH). Nov 1985. 71p. NTIS, PC A04/MF A01.

The report reviews the state-of-the-art of domestic water heater technology. All major R & D efforts since the late 1950's are reviewed and indexed. The maximum efficiencies reported for commercially available heaters are 85% recovery efficiency (ER) with a standby loss (SBL) of 2.4% per hour and an Energy Factor (EF) of .64. Condensing-type water heaters with an ER of over 90% are under development. The review has indicated a need for a residential water heater with an ER of about 85% and a SBL of about 2% per hour. Ideally, this new heater would not require venting into a masonry or Type B vent system and would not require any electrical power.

34197 **(PB—86-157518/XAB) Development of the Battelle Absorption Heat Pump for residential application. Phase 1. Final report, October 1983-May 1985.** Ball, D.A.; Hanna, W.T. (Battelle Columbus Labs., OH (USA)). 23 Oct 1985. 60p. NTIS, PC A04/MF A01.

The report describes the results of the first phase of effort in the development of the Battelle Absorption Heat Pump (BAHP). The BAHP is based on the dual-cycle concept which thermally links two conventional single-effect absorption cycles yielding a high-performance system without the need for high pressures or new, unproven working fluids. Phase I involved construction and testing of three breadboard prototypes, one for each of the two subcycles and a combined, integrated unit. Phase I also involved various supporting analyses in materials, environmental impact, and institutional issues. Breadboard testing was successful in confirming the viability of the concept by meeting the efficiency goals of COP 0.94 in cooling and COP 1.80 in heating. In the supporting analyses, no significant barriers to commercialization were foreseen.

34198 **(PB—86-157906/XAB) Effect of water quality on residential water heater life-cycle efficiency. Annual report, 3 September 1984-August 1985.** Talbert, S.G.; Newman, D.C.; Stickford, G.H.; Stiegelmeyer, W.N.; Locklin, D.W. (Battelle Columbus Labs., OH (USA)). Dec 1985. 213p. NTIS, PC A10/MF A01.

During this long-term field test program, conventional gas and electric water heaters were operated at four different U.S. cities under accelerated test conditions to quantify the effect of scale buildup on performance, and to assess the benefits and limitations of common water-treatment methods. The four test sites were located in Columbus, Ohio; Lisle, Illinois; Roswell, New Mexico, and Marshall, Minnesota. The heaters recovery efficiencies were remeasured at approximately 6-month intervals to determine any changes in recovery efficiency. In addition, corrosion coupons made of steel, galvanized steel, copper, and brass were exposed to the four types of water at each site for periods of up to 9 months. Four gas water heaters will remain on test in Columbus, Ohio for another year.

34199 **(PB—86-158367/XAB) Gas Appliance Technology Center: assessment of the state-of-the-art of gas-fired integrated appliances. Final report, December 1982-December 1983.** Hallinan, K.; Jepson, S.C.; DeWerth, D.W. (American Gas Association Labs., Cleveland, OH). Mar 1984. 86p. NTIS, PC A05/MF A01.

The objective of the report is to provide an up-to-date technical and marketing assessment of gas-fired integrated appliances. The assessment was conducted by the Gas Appliance Technology Center. The oldest integrated system is the combination boiler-

water heater. Several new versions of the system and a few integrated furnace-water heaters are currently marketed. While these integrated space and water heating systems may merit further evaluation, the integrated furnace-clothes dryer concept appears most worthy of further developmental study. A gas furnace-clothes dryer was marketed through 1960, but lost popularity to the electric clothes dryer. A gas-fired energy and space saving integrated furnace-clothes dryer, or perhaps a modular integrated furnace-water heater-clothes dryer, should be attractive to lower income purchasers and renters of condominiums, apartments and factory-built trailer homes.

34200 **(PNL-SA—13096) Comparison of empirically measured end-use metered data with DOE 2.1 simulation.** Heidell, J.A.; Taylor, Z.T. (Pacific Northwest Labs., Richland, WA (USA)). Jul 1985. Contract AC06-76RL01830. 7p. (CONF-850817—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010937.

From Building energy simulation conference; Seattle, WA, USA (21 Aug 1985).

This paper examines how well a DOE 2.1B simulation which has been calibrated for a 20,000 square foot building reflects actual end-use energy consumption. Empirically measured data are compared with simulation results for end-use energy consumption, heating and cooling loads by thermal zone and month, monthly energy use, and monthly peak demand. The limitations of the DOE 2.1 code with respect to modeling the heat pump system are discussed and implications analyzed. An examination of schedules used to model the building highlights the importance of accurate information about building operation and its impacts on the simulation results.

34201 **(PNL-SA—13769) Designing building metering experiments and the second law of ELCAP.** Stokes, G.M.; Hauser, S.G. (Pacific Northwest Labs., Richland, WA (USA)). Feb 1986. Contract AC79-83BP13795;AC06-76RL01830. 11p. (CONF-8604109—6). NTIS, PC A02/MF A01; GPO Dep. File Number DE86011131.

From Pacific Gas and Electric (PG&E) energy expo; Oakland, CA, USA (29 Apr 1986).

Many load and conservation research issues appear to be best addressed through the collection of high-time resolution electrical consumption data from a large number of buildings. The sheer volume of the data collected in such programs can overwhelm an analyst. This is particularly true if the data is subject to subtle quality problems that might bias the results. The design of the large building metering program known as the End-Use Load and Conservation Assessment Program (ELCAP) is presented as one approach that may eliminate some of the hazards inherent in large-scale metering programs. Key concepts in this design are a rigidly controlled method of documenting the metering protocol in individual buildings and the treatment of the entire metering effort, from field data acquisition system to final analysis, as an integrated system.

34202 **(OA-Trans—2792) Energy-saving potential of electrical domestic applications. Third progress report, 1978-1984.** (Overseas Relations Branch Translation Service, London (UK); Zentralverband der Elektrotechnischen Industrie e.V. (ZVEI), Frankfurt am Main (Germany, F.R.)). Apr 1986. Translation source information not available . 11p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86901438.

In 1980 representatives of the German electrical appliance industry made voluntary commitment to the Federal Minister for the Economy to reduce the specific energy consumption of appliances sold in the FRG, and to report results at 2-yearly intervals. The present report updates the figures to 1984. The calculation method, based on the weighted arithmetic mean, is presented. Results are tabulated separately for washing machines, dishwashers, ovens, refrigerators and freezers, and storage-type water heaters. The main reasons to account for the reduced energy consumption are given in each case.

34203 **(ORNL/tr—86/8) Solid adsorption thermodynamic cycle: application to home heat pumps and cold production by solar energy.** Meunier, F.; Brandon, B. (Oak Ridge National Lab., TN (USA); Centre National de la Recherche Scientifique, 91 - Orsay (France). Lab. de Thermodynamique des Fluides; Centre Technique des Industries Aerauliques et Thermiques (CETIAT), 75 - Paris (France)). 1986. Contract AC05-84OR21400. Translation source information not available . 26p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86011103.

The use of high temperature heat from the combustion of various fuels for low temperature use (space heating) or the use of medium temperature heat for the production of cold are two examples of the necessity of research on cycles that allow adaptation of the supply and demand of temperature sources with a minimum deterioration of this heat. This paper presents complementary results on the work in progress on the pseudo-continuous zeolite-H_2O cycle in the light of its application for the heat pump and also for the production of cold.

34204 **Variable effect desorber-resorber absorption cycle.** Biermann, W. J. (to The United States of America as represented by the United States Department of Energy). US Patent 4,542,629. 24 Sep 1985. Filed date 5 Nov 1984. vp. PAT-APPL-668431.

An absorption refrigeration system has an intermediate temperature desorber-resorber pair. A valve between the desorber-resorber pair is modulated to control the capacity for load matching.

34205 **(OA-Trans—2736) Energy balance of the living area of a dwelling.** Truemper, H.; Hain, K. Translated from *Elektrowaerme International ;* **43**: No. A1, A24-A27(Jan 1985). 11p. Overseas Relations Branch, Electricity Council, 30 Millbank, London SW1P 4RD.

Four variants of ventilating systems for dwellings are presented. They comprise simple transverse ventilation in accordance with the Provincial Building Regulations, an old design of stack ventilation in accordance with DIN 18017, a ventilation system with heat recovery in accordance with VDI 2088, and a system using heat recovery and a heat pump. The energy balances of the 4 systems are illustrated by means of energy-flow diagrams. (author).

34206 **Residential gas-fired space-conditioning research and development at Brookhaven National Laboratory.** Woodworth, L.M. (Brookhaven National Laboratory, Upton, NY). pp 119-129 of Future alternatives in residential/commercial space conditioning. Chicago, IL; IGT Document Center (1981).

From Symposium on future alternatives in residential/commercial space conditioning; Chicago, IL, USA (12-14 Jun 1980).

Various options exist for the development of more efficient advanced space-conditioning equipment. The three basic approaches are (1) increasing the capacity of the heat exchanger, (2) operating with a reduction in excess air, and (3) lowering standby and cycling losses. Ideally, a conventional boiler or furnace would allow the heat exchanger to operate in the condensing mode at a temperature suitable for recovering the latent heat of vaporization of water vapor in the flue gas; the resulting efficiency can approach 95%. BNL's gas-fired heating equipment R&D work involves (1) a variable-firing-rate gas burner, (2) a gas-fired pulse-combustion furnace capable of firing 40,000-90,000 Btu/hr, (3) a gas-fired pulse-combustion boiler with an output of 36,000 Btu/hr, (4) a gas-fired heat-pipe furnace firing at 60,000 Btu/hr, and (5) a nonelectric Rankine-cycle gas furnace. A materials program is under way to identify cost-effective materials for condensing oil- and gas-fired systems, and a recent study identified a technology for improving the efficiency of heating systems.

34207 **Absorption heat pumps.** Murphy, K. (Allied Corp., Morristown, NJ). pp 223-226 of Future alternatives in residential/commercial space conditioning. Chicago, IL; IGT Document Center (1981).

From Symposium on future alternatives in residential/commercial space conditioning; Chicago, IL, USA (12-14 Jun 1980).

With support from Gas Research Institute and the US Department of Energy, Allied Corp. developed a refrigerant-absorber pair - (1) R133a CF_3CH_2CL as a refrigerant and (2) ethyltetrahydrofurfuryl ether - for use in a residential absorption heat-pump system. A secondary loop (glycol water) exchanges heat with the evaporator, condenser, and absorber. The heat released by the system flows through the evaporator for the chilling effect. A simple valve in the water circuit switches the system from heating to cooling. The configuration is adaptable to either indoor or outdoor applications.

3202 Transportation

34208 (ATR—83(3869)-2ND) Examination of the effects of tire design on vehicle rolling resistance and fuel economy. Levine, D.L. (Aerospace Corp., El Segundo, CA (USA). Energy Conservation Directorate). Feb 1983. Contract AI01-82CS50286. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86010889.

This report examines the current and expected future trends in highway tire design and their effects on vehicle rolling resistance and fuel economy. The primary emphasis is on passenger cars, operated under conditions typified by the US Environmental Protection Agency Urban, Highway, and Combined Cycles, and heavy duty trucks operated over the road. Analytical and experimental data indicate rolling resistance-fuel economy sensitivity factors of 0.2 for passenger cars over the Combined Cycle, and 0.4 for a fully loaded tractor-van trailer at 55 mph. Improved radial construction, low hysteresis materials, and higher inflation pressures are the primary mechanisms through which passenger car tire rolling resistance has been reduced. Further design refinements are expected in the near future to achieve reduced rolling resistance and optimal ride and handling qualities at acceptable production cost. Similarly, heavy duty truck tire designs have been improved through the use of radial construction, and further rolling resistance reduction is expected through design modifications such as lower aspect ratio.

34209 (PB—86-154192/XAB) Energy conservation in transportation. Final report. Stowers, J.R.; Boyar, V.W. (National Research Council, Washington, DC (USA). Transportation Research Board). Dec 1985. 36p. (TRB/NCHRP/SYN—121). NTIS, PC A03/MF A01.

The synthesis will be of interest to transportation planners, administrators, and others concerned with fuel conservation in transportation. Information is presented on energy use and conservation in various modes of transportation. In recent years, fuel shortages and surpluses, recession, changes in government emphasis, and vehicle-design changes have had significant effects on energy conservation in transportation. The report of the Transportation Research Board gives data on energy conservation measures for automobiles, trucks, transit, railroads, and other areas.

3203 Industry And Agriculture

REFER ALSO TO CITATION(S) 33698, 34105, 34157, 34319

34210 (DOE/CE/15186—T1) Dyna-bite tractor tire attachment performance in clay soil. Walker, J.T. (Arkansas Univ., Fayetteville (USA). Dept. of Agricultural Engineering). 15 Jul 1985. Contract FG01-84CE15186. 40p. University of Arkansas, Fayetteville, AR 72701. File Number TI86010282.

The two Dyna-bite traction-aid devices provided tractive performance that was generally better than regular two-wheel-drive tractor tires under a variety of conditions. The DB1 device reduced wheel slip by 30 to 79% in a variety of soil conditions. The DB1 device also provided 36 to 43% increase in power in dry, firm or disked soil and improved fuel efficiency from 30 to 109% under a variety of conditions. The DB3 device reduced wheel slip by 25 to 75% during the study and resulted in 37 to 40% increase in power in the dry, firm and diaked soil. The DB3 device also resulted in 27 to 91% increase in fuel efficiency. The traction-aid devices provided most benefit for reduction of wheel slip under wet, muddy soil conditions where the regular tires would barely move the tractor with no draft. The FWA tractor also provided improvements over the 2WD tractor: 58 to 73% reduction of wheel slip, 43 to 47% increase in drawbar power in the moist and dry, disked soils; and 26 to 91% increase in fuel efficiency under the various soil conditions. Although the tire attachments can provide benefits in traction over the 2WD treatment, they did not perform better than the FWA tractor. The FWA tractor provided less wheel slip than both tire attachments on the dry, disked and moist soil conditions but performed about the same as the tire attachments in muddy conditions. The DB3 device provided substantial improvements (speed, slip, power, and efficiency) over the worn tire treads to which it was attached (DB0).

34211 (DOE/CE/40646—T5) Adhesives for the composite wood panel industry. Final report. Koch, G.S.; Klareich, F.; Exstrum, B. (Hagler, Bailly and Co., Washington, DC (USA)). 13 Jan 1986. Contract AC01-84CE40646. 141p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE86010847.

Significant energy savings could be realized if current fossil fuel-based resins could be replaced with alternative biomass-derived adhesives. Hence, a program was performed to analyze the current wood panel adhesives market, identify both domestic and international R and D efforts in the area of biomass-derived alternative adhesives that might serve as substitutes for conventional fossil fuel-based adhesives, and assess the technical and economic factors that will influence commercial success of these alternative adhesives.

34212 (DOE/CS/40290—T3) Energy effective systems for closed loop treatment of electroplating waste water. Final report. Williamson, R.C.; Williamson, W.R. (Licon, Inc., Pensacola, FL (USA)). 17 Mar 1986. Contract AC07-79CS40290. 60p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86007851.

A closed loop, energy efficient system has been developed for recycling aqueous electroplating wastes. It is termed a distiller/concentrator system which uses advanced evaporation technology to reduce capital and energy costs. The closed loop operation resolves water pollution problems with nearly zero discharge, recovers high quality water for rinsing, and recovers plating chemicals at bath strength for reuse. The use of heat pump principles significantly reduces energy requirements. A new heat exchanger design termed BAT (Bayonet Augmented Tube), developed under the contract, provided the high heat transfer rates necessary for high energy efficiency and, when available, waste heat utilization.

34213 (DOE/ID/12441—T1-Vol.1) Role of abrasion and corrosion in grinding media wear. Volume 1. Moore, J.J.; Iwasaki, I. (Minnesota Univ., Minneapolis (USA). Mineral Resources Research Center). [1986]. Contract FC07-83ID12441. 143p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE86009471.

Purpose of this project was to investigate the effect of grinding conditions, e.g., pH, P/sub O_2/, grinding media composition and, in particular, size of mill on the wear rates and wear mechanism for both a molybdenite ore and a magnetic iron ore. This allowed data to be obtained on the correlation of scale-up between small diameter laboratory mills and industrial mills and provided a relatively inexpensive test method to be developed for the selection of grinding media used with different ores. Secondly, the effect of the physico-chemical properties of the slurry on wear mechanism(s) and wear rates was evaluated using various slurry media and additives. Results of this work were aimed at providing information from which a more efficient selection of grinding media and conditions may be made which will reduce the total energy consumed in the grinding of minerals.

34214 (DOE/ID/12480—1) Energy efficient membrane separation processes for the corn wet milling industry. Phase I, final report. Gregor, H.P. (Mavdil, Inc., New York (USA)). Jul 1985. Contract AC07-83ID12480. 152p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE86010790.

High solubles water, the principal recycle stream in corn wet milling, is about 3.5% in total solids. Suspended solids 10 to 50 microns in diameter constitute an appreciable fraction of the total solids. Also present are dissolved solids of molecular weight above

1000, carbohydrate and denatured protein, plus a micellar complex of Mg with phytic and lactic acid. Ultrafiltration at a high rate of crossflow with a M-AL-500 membrane effectively removed all of these materials. The feed channel contained 1/16 inch conventional netted plastic separator material. The average flux at 30 psig at 40°C was 24 gfd. The UF permeate was treated by RO at 40°C and 900 psig using FilmTec FT-30 membranes to produce a high quality permeate water for re-use and a combined UF-RO concentrate to be fed to the evaporator. A design and economic study based on these results suggests that energy requirements for a typical milling plant can be reduced by 47% or the equivalent of 60,000 barrels of oil yearly.

34215 (DOE/ID/12550—1) Design study of plastic film heat exchanger. Final report. Guyer, E.C.; Brownell, D.L. (Dynatech R/D Co., Cambridge, MA (USA)). 19 Feb 1986. Contract AC07-84ID12550. 105p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE86011040.

This report presents the results of an effort to develop and design a unique thermoplastic film heat exchanger for use in an industrial heat pump evaporator system and other energy recovery applications. The concept for the exchanger is that of individual heat exchange elements formed by two adjoining and freely hanging plastic films. Liquid flows downward in a regulated fashion between the films due to the balance of hydrostatic and frictional forces. The fluid stream on the outside of film may be a free-falling liquid film, a condensing gas, or a noncondensing gas. The flow and structural principles are similar to those embodied in an earlier heat exchange system developed for use in waste water treatment systems (Sanderson). The design allows for high heat transfer rates while working within the thermal and structural limitations of thermoplastic materials. The potential of this new heat exchanger design lies in the relatively low cost of plastic film and the high inherent corrosion and fouling resistance. This report addresses the selection of materials, the potential heat transfer performance, the mechanical design and operation of a unit applied in a low pressure steam recovery system, and the expected selling price in comparison to conventional metallic shell and tube heat exchangers.

34216 (DOE/ID/12550—T2) Design of heat exchange element for plastic film heat exchanger. Guyer, E.C.; Brownell, D.L. (Dynatech R/D Co., Cambridge, MA (USA)). 28 Dec 1984. Contract AC07-84ID12550. 41p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86011042.

This report presents the results of an effort to design a plastic film heat exchanger element (PFHX) suitable for use in an industrial heat pump evaporator. This report addresses the selection of materials, the expected flow and heat transfer behavior, and the mechanical design features of a parallel plate type exchanger that uses thin plastic films as the boundary between the two process fluids. Criteria for material selection are presented, candidate materials are reviewed, and material recommendations are provided. Heat transfer performance is addressed in terms of the overall or total coefficient of heat transfer between condensing steam and a confined falling film of water. Appropriate mechanical designs of water flow manifolds are described along with methods of fabrication and assembly. This report addresses only the individual heat exchange element.

34217 (DOE/ID/12558—T1) Improved industrial humidity sensors and control systems. Dew point hygrometer. Phase 1. Final report. Sulouff, R.E.; Randazzo, T.A. (Honeywell, Inc., Plymouth, MN (USA). Solid State Electronics Div.). Nov 1985. Contract FC07-84ID12558. 119p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE86011052.

A capacitive dew point hygrometer was designed, fabricated, and tested for applications in industrial grain drying environments. This report describes the system development and the results of the fabrication and sensor evaluations. The dew point sensor was fabricated on silicon to provide a capacitive condensate detector that could detect liquid water or ice on the surface. The change in capacitance occurs due to the higher dielectric constant of water over air and results in an increase of capacitance from 25 pF dry to 40 pF completely wet. An integrated permalloy resistance temperature device (RTD) was also present on the surface of the sensor.

34218 (EGG—2408) Comparative economic evaluation of industrial heat pumps. Bliem, C.J.; Mills, J.I.; Chappell, R.N. (EG and G Idaho, Inc., Idaho Falls (USA)). Apr 1986. Contract AC07-76ID01570. 128p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE86011183.

This report presents the findings of a study on the cost of delivering process heat with state-of-the-art heat pump systems. Results of this study will be used to define economic performance which must be met or improved upon by advanced heat pump concepts in order to warrant Department of Energy (DOE) development support. Sixteen heat pump systems were configured for relative cost comparisons. These systems consisted of electrically driven, prime energy driven, and waste energy driven reverse Rankine cycle heat pumps of the open, semiopen and closed type. In addition, a waste energy driven absorption heat pump was analyzed. A conceptual design of each system was created using off-the-shelf components generally available to engineering firms. The performance of each system was assessed, the major components sized, and the installed cost determined. Maintenance costs were estimated. Finally, the relative cost of energy delivered by each system was estimated, and the cost of delivery heat with state-of-the-art heat pumps was determined.

34219 (EPRI-EM—4549) Energy management pilot program for industry. Final report. McChesney, H.R. (United Technologies Research Center, East Hartford, CT (USA). Advanced Systems Technology). May 1986. 58p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920301.

Utilities can provide a valuable service to their industrial customers by identifying cost-saving ways to conserve energy in industrial processes. Proven in this pilot program, an EPRI energy conservation and management computer model is available to utility customer service departments for critically evaluating industrial plant operations.

34220 (EPRI-EM—4576-Vol.1) Cogeneration for industrial and mixed-use parks. Volume 1. A handbook for utilities. Final report. Schiller, S.R.; Minicucci, D.D.; Tamaro, R.F. (Impell Corp., Walnut Creek, CA (USA)). May 1986. 101p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920313.

The purpose of this handbook is to assist utility personnel in identifying existing or planned mixed-use and industrial parks as potential cogeneration plant sites. This handbook describes a process for evaluating the potential of a given site for cogeneration. The process involves a set of screenings, based on selection criteria and some basic analyses, to identify sites which have the highest likelihood of supporting a successful cogeneration project. Also included in the handbook are worksheets and case studies.

34221 (EPRI-EM—4576-Vol.2) Cogeneration for industrial and mixed-use parks. Volume 2. A handbook for utilities, Appendixes C and D. Final report. Schiller, S.R.; Minicucci, D.D.; Tamaro, R.F. (Impell Corp., Walnut Creek, CA (USA)). May 1986. 108p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303. File Number TI86920314.

Purpose of this handbook is to assist utility personnel in identifying existing or planned mixed-use and industrial parks as potential cogeneration plant sites. These two appendices cover the case study: potential cogeneration sites identification; and load, system, and economic feasibility analysis.

34222 (EPRI-EM—4576-Vol.3) Cogeneration for industrial and mixed-use parks. Volume 3. A guide for park developers, owners, and tenants. Final report. Schiller, S.R.; Minicucci, D.D.; Tamaro, R.F. (Impell Corp., Walnut Creek, CA (USA)). May 1986. 24p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920315.

Using cogeneration in mixed-use and industrial parks can cut energy costs ad smooth out peak load demands - benefits for servicing utilities and park owners and tenants. The two handbooks developed by this project can help utilities identify existing or planned parks as potential cogeneration sites as well as help developers and park owners evaluate the advantages of cogeneration.

The second handbook (volume 3) describes the benefits of cogeneration for park developers, owners, and tenants.

34223 (MTI—85TR25) Development of multiapplication low-level heat recovery technology. (Mechanical Technology, Inc., Latham, NY (USA)). 29 Mar 1985. Contract FC07-78ET11389;AC07-79ET15333;AC07-76OR04083. 112p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE86011055.

This report summarizes work conducted to develop and demonstrate technologies for recovery of industrial waste heat. The first portion of the work, done under ERDA contract, was performed from 1976 to 1980. A system was developed for generating electric power from exhaust discharged from diesel engine generator sets used in municipal power plants. This work was of an exploratory nature and combined the technology of a low-pressure steam system with that of an organic Rankine-cycle (ORC) system in a single binary cycle system.

34224 (NP—6751996) Natural gas in the aluminium industry. Energy conservation in melting and heat treatment. (Ruhrgas A.G., Essen (Germany, F.R.)). 1984. 57p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE86751996.

Many innovations in aluminium melting and heat treatment are concerned with the reduction of natural gas consumption. The melting and heat treatment processes and the furnace systems required are described, and their operating characteristics are illustrated by practical examples. Fuel consumption can be reduced by optimizing and controlling the fuel mixture, by controlling the furnace chamber pressure, and by preheating the metal and the combustion air. Several furnace systems were compared on the basis of their energy demand, efficiencies, and heat balances. Optimisation measures are discussed. (HLN).

34225 (ORNL/Sub—85-00219/1) Summary and evaluation of field performance data on unitary heat pumps. Burke, J.C.; Fitzgerald, K.F.; Frantzis, L. (Little (Arthur D.), Inc., Cambridge, MA (USA)). Apr 1986. Contract AC05-84OR21400. 126p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE86011289.

Thirty-eight programs involving over 700 heat pump units were categorized in three levels: Level I programs measured energy input normally using utility load research methods, to obtain semi-quantitative performance information and "hands on" operating experience. In Level II programs (almost 150 units) both energy input and output were obtained allowing estimation of HSPF. Level III programs involved measurement of input, output and at least some isolation of dynamic losses due to part load cycling and frost/defrost. Energy input data is abundant and frequently reliable but the results are seldom either statically valid or easily generalized. A considerable amount of HSPF (and much less SEER) data is also available. Certain comparisons of these experimental performance factors with ARI 240-81 predictions have indicated good apparent agreement. Dynamic losses can degrade seasonal performance by over 20% in some instances. Unresolved experimental problems include optimization of flip-flop techniques, practical field measurement of cooling load and means of detecting performance degradation. Also very few programs presented error analyses.

34226 (PB—86-153186/XAB) Energy at sawmills. Special report. Taylor, R.W. (National Timber Research Inst., Pretoria (South Africa)). Aug 1982. 43p. (CSIR/SR/HOUT—264). NTIS, PC A05/MF A01.

The report is the first in a study of the energy use of sawmills. Data were collected from three reasonably representative coniferous sawmills in the Transvaal. The analyses of the data indicate that electrical energy consumption averaged 73 MJ/m^3 of roundwood intake, while thermal energy (steam) averaged 2046 MJ/m^3 and liquid fossil fuels 12 MJ/m^3. Heat energy (steam) made up more than 95% of the energy used.

34227 (PB—86-153673/XAB) Industrial rotary engine development - application opportunities. Final report, January-November 1985. Guidry, J.D. (Deere and Co., Moline, IL (USA); Gas Research Inst., Chicago, IL (USA)). Nov 1985. 170p. NTIS, PC A08/MF A01.

The study examines the economic feasibility of manufacturing natural-gas rotary engines for cogeneration and industrial variable-speed applications. Cogeneration and variable speed potential is evaluated by market segment and projected to the year 2000. Market penetrations possible for natural gas rotary are estimated for each market segment. The benefits of manufacturing a natural-gas rotary engine for cogeneration and variable-speed applications to the energy consumer, to total energy conservation, the gas industry, and the natural-gas rotary engine manufacturer are also discussed. The study concludes that total benefits warrant a program to develop a natural-gas rotary engine for eventual sale.

34228 (PB—86-153988/XAB) Evaluation of the technical potential for cogeneration in Illinois. Couglan, S.T.; Parker, L.; Limaye, D.R. (Synergic Resources Corp., Bala-Cynwyd, PA (USA)). Jan 1986. 115p. NTIS, PC A06/MF A01.

The study evaluates the technical potential of cogeneration in Illinois by technology, capacity, and utility-service territory.

34229 (PB—86-157450/XAB) High-temperature burner with heat exchanger. Annual report, March 15, 1983-March 14, 1984. Davies, T.; Bowers, J. (North American Mfg. Co., Cleveland, OH (USA)). Mar 1984. 46p. NTIS, PC A03/MF A01.

The report describes the first year's effort in the development of radiant tube and direct fired burners which have integral regenerators for heat recovery. The work has involved the development of burners and control system including actuators, valves, and controls. Future project plans are also outlined. Prototype designs will be finalized. Host-site furnaces are being located and will prove burner performance and economics in manufacturing-plant conditions.

34230 (PB—86-161502/XAB) Energy in New Zealand greenhouses. Final report. Breuer, D.R. (Pacific Energy Design Ltd., Auckland (New Zealand)). Jul 1985. 83p. NTIS, PC A04/MF A01.

Literature reviews were undertaken to establish the size and characteristics of the NZ greenhouse industry and collect all the available information on its use of energy. Research and advisory services to the industry were also reviewed. Overseas literature was studied to see if overseas energy-conservation techniques might be applicable here and determine whether current overseas research might have future application here. Results of the reviews were presented as a preliminary report to a two-day seminar/workshop for growers and researchers. Information and ideas from the seminar are incorporated into this final report. A special study was also carried out to obtain information on the attitudes of greenhouse operators to energy use.

34231 (PB—86-161718/XAB) Fuel use control in the fishing industry. Final report. Billington, G. (New Zealand Fishing Industry Board, Wellington). Aug 1985. 20p. NTIS, PC A03/MF A01.

The project undertook fuel flow monitoring of a random sample of fishing vessels in the New Zealand fishing industry. The object of the project was to determine the value of fuel flow measurement on a range of vessels of differing size and fishing method, and to investigate the effect on fuel consumption of hull fouling and propeller repitching where this appeared to be required. Eight vessels in the port of Tauranga were included in the trials. Three of these are company-owned and operated and the remainder are owner-operated. One purse seiner, two longliners and five trawlers (pair and single) were involved. Fuel flow measurements were carried out, with before-and-after tests on one vessel to determine the value of removing hull fouling. In two cases propeller repitching was undertaken. The tests demonstrated that five of the eight vessels could, through minor operational changes, make significant fuel conservation gains with minimal loss of performance.

34232 (PB—86-161726/XAB) Developments in direct-drilling techniques. Final report. Choudhary, M.A.; Baker, C.J. (Massey Univ., Palmerston North (New Zealand)). Sep 1985. 26p. NTIS, PC A03/MF A01.

The report outlines methods and techniques of measuring in-groove r.h.% in the direct drilled seed micro-environment, as an indirect performance assessment tool for evaluating seed drill openers. A number of laboratory and field experiments, which used various direct drilling openers to sow crops and pasture, are described. The laboratory study highlighted design characteristics of opener types suitable for more fail-safe direct drilling in untilled soils. The results obtained in the field experiments indicate a strong potential for determining soil and climatic classification systems which might predict the suitability of direct drilling methods of crop and pasture production in different areas and soils. The study, however, did not have time to define such a classification system. The overall objective of this and complimentary studies on the topic at Massey University, has been to increase the reliability of the practice of direct drilling (zero-tillage), so that farmers will increasingly cease conventional tillage in favor of this new and very fuel-efficient optional method of crop and pasture establishment.

34233 Coupled dual loop absorption heat pump. Sarkisian, P. H.; Biermann, W. J.; Reimann, R. C. (to The United States of America as represented by the United States Department of Energy). US Patent 4,542,628. 24 Sep 1985. Filed date 13 Nov 1984. vp.

PAT-APPL-670099.

A coupled dual loop absorption system which utilizes two separate complete loops. Each individual loop operates at three temperatures and two pressures. This low temperature loop absorber and condenser are thermally coupled to the high temperature loop evaporator, and the high temperature loop condenser and absorber are thermally coupled to the low temperature generator.

3206 Municipalities And Community Systems

REFER ALSO TO CITATION(S) 33879

34234 (ANL/EES-TM—299) Econometric model of the joint production and consumption of residential space heat. Klein, Y.L. (Argonne National Lab., IL (USA)). Dec 1985. Contract W-31-109-ENG-38. 66p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86010570.

This study models the production and comsumption of residential space heat, a nonmarket good. Production reflects capital investment decisions of households; consumption reflects final demand decisions given the existing capital stock. In the model, the production relationship is represented by a translog cost equation and an energy factor share equation. Consumption is represented by a log-linear demand equation. This system of three equations - cost, fuel share, and final demand - is estimated simultaneously. Results are presented for two cross-sections of households surveyed in 1973 and 1981. Estimates of own-price and cross-price elasticities of factor demand are of the correct sign, and less than one in magnitude. The price elasticity of final demand is about -0.4; the income elasticity of final demand is less than 0.1. Short-run and long-run elasticities of demand for energy are about -0.3 and -0.6, respectively. These results suggest that price-induced decreases in the use of energy for space heat are attributable equally to changes in final demand and to energy conservation, the substitution of capital for energy in the production of space heat. The model is used to simulate the behavior of poor and nonpoor households during a period of rising energy prices. This simulation illustrates the greater impact of rising prices on poor households.

34235 (PB—86-155579/XAB) Factors affecting composting of municipal sludge in a bioreactor. Final report. Hoitink, H.A.J.; Kuter, G.A. (Ohio Agricultural Research and Development Center, Wooster (USA)). Jan 1986. 113p. NTIS, PC A06/MF A01.

The research was initiated to determine the feasibility of composting municipal sludge in an aerated-tank bioreactor system and to develop baseline data for the rational operation and design of enclosed-reactor-composting systems. A variety of conditions was tested, and various mixtures of recycled compost, bark, and sawdust were used as bulking agents. The mean temperature of the compost was regulated through programmed rates of airflow. Material balances were determined from accurate measurements of the weights of solids and water in the reactor feed and reactor product. In addition, temperature, aeration and carbon dioxide evolution were monitored continuously. Losses of water and solids experienced in the system were significantly greater than those published for the static aerated-pile system. Measurements of carbon dioxide evolution appeared to accurately reflect the destruction of volatile solids and indicated that activity was at an optimum when the mean temperature of the compost was maintained at 38-55 C under high rates of aeration.

3209 Education And Public Relations

REFER ALSO TO CITATION(S) 33669

34236 (CONF-850339—, pp 117-122) Status of energy education in the US. Yager, R.E. (Univ. of Iowa, Iowa City). Dec 1985. NTIS, PC A12/MF A01. File Number DE86007984.

From California offshore petroleum conference; Long Beach, CA, USA (26 Mar 1985).

The author describes the relatively new field of energy education in the elementary-secondary school level. He outlines program goals, curriculum organization, learning activities, and teacher characteristics of the National Science Teachers Association (NSTA). NSTA cited eight programs in different states which provide a meaningful learning environment for students in the new study area of energy education that can serve as models for other schools. The programs emphasize problem solving in an approach that can carry over into other areas of the science curriculum to improve student understanding about the relevance of science.

34237 (CONF-850339—, pp 127-132) Energy and environmental education program. Garner, G.J. (Los Angeles Unified School District, CA). Dec 1985. NTIS, PC A12/MF A01. File Number DE86007984.

From California offshore petroleum conference; Long Beach, CA, USA (26 Mar 1985).

A review of energy and environmental education programs and materials also describes how these programs and materials are made available for use in elementary and secondary schools and how they are used in classrooms. Most of the programs are designed to supplement and enrich the basic instructional programs. Focusing on the Los Angeles area, the author describes the City/County Energy Education Council, its Catalog of Teacher Resources and its in-service training program. His report includes short summaries of a range of programs dealing with energy sources, alternative energy, energy conservation, and waste management.

33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

3301 Internal Combustion Engines

REFER ALSO TO CITATION(S) 33727, 34259, 34259

34238 (AD-A—163917/8/XAB) Parametric analysis of radiation heat transfer in direct injection diesel combustion. Chang, S.L.; Yang, X.L.; Rhee, K.T. (Rutgers--the State Univ., Piscataway, NJ (USA). Dept. of Mechanical and Aerospace Engineering). 1985. 11p. NTIS, PC A02/MF A01.

Radiation heat transfer in a direct injection-type diesel engine is investigated by a computational parametric analysis for various engine and combustion variables. A new model was developed to compute the spectral radiation heat flux incident on various locations in the combustion chamber and to incorporate it with the spectral emissivity of the chamber wall surface. The model mainly differs from previous ones in several ways: 1) it uses the in-cylinder

species distribution; 2) a new coordinate transformation method is introduced, instead of using geometric factors or the zonal method; 3) it computes the spectral volume absorptance of the combustion products through optical paths; 4) a new formulation and integration method are employed for the governing equation of radiation heat flux; etc. The main purpose of the present paper is to report some of the results from a parametric analysis carried out by using the new computational model.

34239 **(ATR—82(2869)-5ND) Wankel rotary engine development status and research needs.** Martin, M.K. (Aerospace Corp., El Segundo, CA (USA). Energy Conservation Directorate). Nov 1982. Contract AI01-82CS50286. 79p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86010888.

This report summarizes the status of Wankel rotary engine technology, particularly as applicable to highway vehicles. The Wankel engine was invented over 25 years ago, and has undergone continual evolutionary design refinement. The engine's perceived advantages of less weight, volume, and complexity than reciprocating engines sparked keen interest, and Wankel-powered automobiles have now been in production for almost 20 years. However, in the early 1970s interest in the Wankel engine greatly subsided because of two problems with the engine at that time: poor fuel economy and high hydrocarbon emissions. The bulk of current Wankel engine development work applicable to highway vehicles is being conducted by Toyo Kogyo (TK) and Curtiss-Wright (C-W). TK has manufactured over 1.2 million rotary engines to date, and markets them in the Mazda Luce and Cosmo in Japan and the Mazda RX-7 worldwide. State-of-the-art production rotary-powered vehicles from TK now exhibit fuel economy which appears to be competitive with many equal-performance, reciprocating-engine vehicles. C-W is focusing its efforts on direct-injection, stratified-charge designs for military and aircraft applications. The company is developing a 750-hp dual-rotor engine for the US Marine Corps, and has completed a design study for a 320-hp general aviation engine. Based on typical reciprocating engines of 1975 to 1977 vintage, and with final drive ratios adjusted to give roughly equal vehicle performance, calculated Environmental Protection Agency (EPA) city fuel economy with the C-W rotary averages 25% higher than with the reciprocating engine. The highway gain is 13%. Use of diesel fuel or a middle distillate instead of gasoline allows an additional 11% gain to be projected on a per-gallon basis. In addition, further gains of 14 to 38% are projected to result from use of a smaller turbocharged version of the engine.

34240 **(ATR—84(4869)-1ND) Fuel economy potential of proposed carburetor concepts.** Levine, A.S.; Levine, D.L. (Aerospace Corp., El Segundo, CA (USA). Energy Conservation Directorate). Jul 1984. Contract AI01-82CS50286. 65p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86010890.

This report reviews the fuel economy improvement potential of carburetor designs proposed for automotive spark ignition engines. In addition, information is presented pertaining to exhaust emissions and driveability effects, system applicability, and development status. The technical basis for the assessment is derived from data available in the open literature and information acquired through communication with carburetor manufacturers and automobile industry representatives. Carburetor concepts proposed for improved fuel economy generally rely on improved metering accuracy and on the mechanisms of improved atomization, vaporization, and cylinder-to-cylinder distribution, which in turn allow the use of leaner air-fuel mixtures to raise cycle thermodynamic efficiency. The devices evaluated are divided into six categories: sonic, atomizing, vaporizing, constant depression, unconventional fuel metering, and conventional designs.

34241 **Feedback regulated induction heater for a flowing fluid.** Migliori, A.; Swift, G. W. (to The United States of America as represented by the United States Department of Energy). US Patent 4,560,849. 24 Dec 1985. Filed date 13 Jun 1984. vp.

PAT-APPL-620287.

A regulated induction heater for heating a stream of flowing fluid to a predetermined desired temperature. The heater includes a radiofrequency induction coil which surrounds a glass tube through which the fluid flows. A heating element consisting of a bundle of approximately 200 stainless steel capillary tubes located within the glass tube couples the output of the induction coil to the fluid. The temperature of the fluid downstream from the heating element is sensed with a platinum resistance thermometer, the output of which is applied to an adjustable proportional and integral feedback control circuit which regulates the power applied to the induction coil. The heater regulated the fluid temperature to within 0.005° C. at a flow rate of 50 cm^3/second with a response time of less than 0.1 second, and can accommodate changes in heat load up to 1500 watts.

34242 **Evaluation of wear-resistant chrome oxide and plasma-spray coatings.** Yonushonis, T.M.; Wolter, G.W. (Cummins Engine Co., Inc., Columbus, IN 47202-3005). pp 1067-1076 of Proceedings of the ninth annual conference on composites and advanced ceramic materials. Columbus, OH; American Ceramic Society, Inc. (1985). (CONF-850122—). Contract AC05-84OR21400.

From 9. annual conference on composites and advanced ceramic materials and workshop on testing methods for ceramic matrix composites; Cocoa Beach, FL, USA (20 Jan 1985).

A factorial-design test program was conducted to determine the effects of piston ring coatings, lubricants, contact stress and cylinder liner coatings on the frictional forces generated and material wear at simulated advanced diesel engine operating conditions. Statistical analysis of the frictional forces revealed significant interactions between the lubricants and contact stresses. Interactions between liner materials and lubricants were also observed during analysis of wear volumes. It was shown that chrome oxide-based liner coatings yielded higher frictional forces, and that the higher contact stress resulted in greater wear volumes.

34243 **An overview of the DOE Advanced Automotive Gas Turbine Program.** Kramer, S.B. Warrendale, PA; Society of Automotive Engineers, Inc. (1985). 7p. (TP—851189). Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096.

In order to determine a viable alternative to the contemporary gasoline engine the Federal Government has sponsored and continues to conduct extensive R & D under contractual arrangements on an Advanced Automotive Gas Turbine Engine. Ceramic materials have been introduced as components of the high temperature regions of the engine so as to increase the thermodynamic and hence the overall efficiency of the gas turbine engine.

34244 **Optical measurements of hydrocarbons emitted from a simulated crevice volume in an engine.** Medina, S.C.; Green, R.M.; Smith, J.R. Warrendale, PA; Society of Automotive Engineers, Inc. (1984). 10p. (TP—840378). Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096.

The process of hydrocarbon emission from an engine crevice was simulated in an operating research engine by the introduction of a small tube into the combustion chamber. This simulated crevice volume was used to determine the fate of unburned hydrocarbons that interact with the crevice. Shadowgraph photography and spontaneous Raman spectroscopy were used to determine flow patterns, temperatures, and hydrocarbon concentrations 1 mm from the tube opening. Hydrocarbon species were first detected at the tube exit late in the expansion stroke, long after the start of outflow from the simulation volume. A flame was never observed near the tube exit. Unburned hydrocarbons exiting the tube did not undergo rapid oxidation at temperatures up to 1400 Kelvins.

34245 **Laser Doppler velocimetry measurements in valved and ported engines.** Liou, T.-M.; Hall, M.; Santavicca, D.A.; Bracco, F.V. Warrendale, PA; Society of Automotive Engineers, Inc. (1984). 14p. (TP—840375). Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096. Contract AC04-81AL16338.

Measurements are presented of bulk velocity and its cyclic variation and of turbulence intensity in IC engines with combustion chambers of open shape. Engines with both ported and valved in-

takes were tested. The ported engine was tested both with and without swirl and the valved engine without swirl only. The ported engine was motored at 1200, 1800 and 2400 RPM and the valved engine at 600, 1200 and 1800 RPM. In both engines the shape of the combustion chamber was such as not to introduce strong organized gas motion during compression. Thus the in-cylinder gas motion, including turbulence, was due primarily to the intake process. The measurements were made using laser Doppler velocimetry as data rates which were sufficiently high to determine the bulk velocity in each cycle and thereby separate the cyclic fluctuations of the bulk velocity from the turbulence.

34246 **The effect of turbulence on the hydrocarbon emissions from combustion in a constant volume reactor.** Isack, A.J.; Askey, J.; Adamczyk, A.A.; Lavoie, G.A.; Kach, R.A. Warrendale, PA; Society of Automotive Engineers, Inc. (1984). 14p. (TP—840366). Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096. Contract AC04-79ET15303.

A cylindrical combustion bomb with dynamic charging system and electro-hydraulic sampling valve is used to study the effects of turbulence on hydrocarbon (HC) emissions from a quench layer and from artificial crevices. The turbulence level is varied by changing the delay time between induction of combustible charge and ignition. Propane-air mixtures were studied over an initial pressure range of 150 to 500 kPa and equivalence ratios of 0.7 to 1.4. Sampling valve experiments show that quench-layer fuel hydrocarbons are extensively oxidized within 5 ms of flame arrival under laminar conditions and that turbulence further reduces the already low level. Upper limit estimates of the residual wall layer HC concentration show that residual quench layer hydrocarbons are only a small fraction of the exhaust HC emission. Artificial crevice experiments show that the exhaust HC emission is directly proportional to crevice volume and that the initial equivalence ratio strongly influences the species distribution in the exhaust. However, the experiments show little effect of turbulence on the HC emission from these crevices.

34247 **Fluid motion during flame propagation in a spark ignition engine.** Witze, P.O.; Martin, J.K.; Borgnakke, C. Warrendale, PA; Society of Automotive Engineers, Inc. (1984). 14p. (TP—840377). Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096.

Laser Doppler velocimeter results are presented for the mean velocity and turbulence intensity measured during combustion in a research engine. Simultaneously with each LDV measurement, the cylinder pressure and gas state (unburned or burned) were measured so that conditional sampling techniques could be used in the data-averaging procedure. Measurements of the mean velocity component in the direction of flame propagation agree well with a computer simulation of the induced velocities generated by the volume expansion of the burned gases. Mean velocities measured parallel to the flame surface are shown to be complex because a small amount of swirl was present. Conditional sampling on the time of flame arrival at the LDV probe volume revealed a thirty percent cyclic-variation bias error in the turbulence component normal to the flame. The turbulence field ahead of the flame appears to be enhanced by compression, with the component normal to the flame increased twice as much as the parallel component.

34248 **State-of-the-art report on the use of alcohols in diesel engines.** Ecklund, E.E.; Bechtold, R.L.; Timbario, T.J.; McCallum, P.W. Warrendale, PA; Society of Automotive Engineers, Inc. (1984). 19p. (TP—840118). Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096.

The concept of using alcohol fuels as alternatives to diesel fuel in diesel engines is a recent one. The scarcity of transportation petroleum fuels which developed in the early 1970's spurred many efforts to find alternatives. Alcohols were quickly recognized as prime candidates to displace or replace high octane petroleum fuels. However, alternatives to the large demand for diesel fuel in many countries were not as evident. Innovative thinking led to various techniques by which alcohol fuels can partially or completely displace diesel fuel in diesel transportation vehicles. The methods of using alcohol fuels in diesel engines (in order of increasing diesel fuel displacement) include solutions, emulsions, fumigation, dual injection, spark ignition, and ignition improvers.

34249 **Three-dimensional flow field in four-stroke model engines.** Arcoumanis, C.; Bicen, A.F.; Vafidis, C.; Whitelaw, J.H. (Imperial College of Science and Technology, London, England). *SAE [Technical Papers]*; No. 841360, 1-10(1984).

From Fuels and lubricants meeting & exposition; Baltimore, MD, USA (8-11 Oct 1984).

Ensemble-averaged and in-cycle axial and swirl velocities have been measured by laser Doppler anemometry in the three-dimensional flow field of a four-stroke model engine motored at 200 rpm with a compression ratio of 6.7 and various cylinder head and piston geometries. The inlet configurations comprised an axisymmetric port with a shrouded valve and an off-center port with two valve and swirl generating vane geometries. The piston configurations comprised flat, cylindrical and re-entrant axisymmetric piston-bowls. The results indicate that with the off-center port a complex vortical flow pattern is generated during induction, which later either collapses in the absence of induction swirl or is transformed into a single rotating vortex in the transverse plane when swirl is present. The axisymmetric port with the shrouded valve gives rise to a double vortex structure and higher turbulence levels at TDC of compression compared to the off-center port. The in-cycle swirl velocities indicate that the swirl center oscillates during the compression stroke in phase, on the average, with the piston motion with associated turbulent fluctuations of smaller magnitude than the cycle-to-cycle velocity variations. 15 references, 13 figures.

3303 Electric-powered Systems

REFER ALSO TO CITATION(S) 34104

34250 **Analysis of electric vehicle operational data from versatile data acquisition systems.** Kevala, R.J.; Kwan, Q. Warrendale, PA; Society of Automotive Engineers, Inc. (1985). 11p. (TP—850227). Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096.

A microprocessor-based onboard data collection device was developed and installed on three electric vehicles (EVs) being tested at Fort Belvoir, Virginia, and at Northrop Aircraft Division, Hawthorne, California. This device, the Versatile Data Acquisition System (VDAS), collects and stores selected EV and battery performance data in histogram format. Some time-domain data are also collected. This paper presents the results of an analysis of these data. The analysis shows that histograms of trip distances, trip times, road gradients, and velocities provide useful measures or indicators of daily site operations. Engineering performance indicators such as ac and dc energy consumption per mile, battery power and energy demands, battery charging profiles, and component temperature extremes are developed. The authors conclude that VDAS installations can bridge the gaps between simulations, laboratory tests, and field tests of EVs.

34251 **Development of driving schedules for Advanced Vehicle Assessment.** Deshpande, G.K. Warrendale, PA; Society of Automotive Engineers, Inc. (1984). 5p. (TP—840360). Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096.

The Advanced Vehicle (AV) Assessment is an activity being performed by JPL for the Electric and Hybrid Vehicle Division of the U.S. Department of Energy to evaluate subsystem developments for Advanced Vehicle applications in the 1990s. The AVs are vehicles powered by nonpetroleum alternatives such as advanced batteries and fuel cells. This paper describes the methodology used to develop the driving schedules that characterize annual driving. The 1978 National Personal Transportation Study was used as a basis for this analysis. The methodology used consists of a Monte Carlo simulation model that uses the trip frequency distribution and trip length frequency distribution to develop estimates of daily driving distances. These are then combined with the distribution of starting time of the first trip and mean time between trips to develop travel for each of the days in a year. Twelve such schedules, representing a range of daily travel distances from 4 km to 400 km, were devised for simulating the automobile use patterns for

Advanced Vehicle Assesment. The annual fuel and energy consumption was based on the number of days each of the 12 daily travel distances was driven. The method used to develop these schedules has allowed for a more realistic assessment of the AV power sources compared to the use of continuous urban cycles for vehicle simulation.

34252 **Simulated performance of solid polymer electrolyte fuel-cell-powered vehicles.** Lynn, D.K.; Murray, H.S.; McCormick, J.B.; Huff, J.R. (Los Alamos National Lab., NM). *Society of Automotive Engineers Technical Paper Series;* 1-6(1983).

From International congress and exposition; Detroit, MI, USA (28 Feb 1983).

Fuel cells offer a number of attractive features as alternate power sources for transportation applications. Potential advantages include high efficiency, good performance operation on nonpetroleum fuel and negligible pollution. General Electric (GE) assessed solid polymer electrolyte (SPE) fuel cells specifically for automotive applications. The results of this assessment are used to calculate the performance and fuel consumption of the Gm X Car and of the GE Chrysler Electric Test Vehicle 1 (ETV-1). The X car was calculated to have good performance, negligible emission, and substantially reduced energy consumption. The calculated performance of the ETV-1 with an SPE fuel cell is comparable to that of a present day, small gasoline-powered passenger car. In addition, the calculated fuel consumption is 33 mpg of methanol, equivalent to 66 mpg of gasoline on an energy basis. 13 references, 7 figures, 4 tables.

3307 Emission Control

REFER ALSO TO CITATION(S) 34770, 34770

34253 **(PB—86-135811/XAB) Application for certification, 1986 model year light-duty vehicles - Chrysler.** (Chrysler Corp., Detroit, MI (USA)). 1985. 2357p. NTIS, PC A99/MF A01.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles, or heavy-duty engines submits to EPA an application for certification. In the application, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. These engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. It also provides information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. Section 16 of the application contains the results of emission testing, a statement of compliance to the regulations, production engine parameters, and a Summary Sheet Input Form on which issuance of a Certificate of Conformity is based.

34254 **(PB—86-135894/XAB) Application for certification, 1986 model year light-duty vehicles - American Motors Corporation/Renault.** (American Motors Corp., Detroit, MI). 1985. 1454p. NTIS, PC A99/MF A01.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles, or heavy-duty engines submits to EPA an application for certification. In the application, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. These engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. It also provides information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. Section 16 of the application contains the results of emission testing, a statement of compliance to the regulations, production engine parameters, and a Summary Sheet Input Form on which issuance of a Certificate of Conformity is based.

34255 **(PB—86-148665/XAB) Diagnostics for emission-control-system malfunction on three-way catalyst-equipped vehicles. Final report, November 1983-November 1985.** Duleep, K.G. (Energy and Environmental Analysis, Inc., Arlington, VA (USA)). Nov 1985. 339p. NTIS, PC A15/MF A01.

The report presents the results of a two part study. In Phase I, the contractor reviewed current manufacturer recommended diagnostic procedures for identifying vehicular emission control malfunctions on three-way catalyst-equipped gasoline-fueled automobiles and also surveyed diagnostic techniques used in the field. Diagnosis of malperformance was limited to the following systems: exhaust gas recirculating, secondary air, fuel, and catalyst. In Phase II, the contractor developed generalized diagnostic procedures for malfunctioning emission control systems and validated these procedures on 52 vehicles. Two mechanics alternatively disabled and repaired the vehicles using the diagnostic and repair procedures. The report also describes inspection procedures developed for the control of smoke emissions from light-duty diesel vehicles. Two types of procedures were developed, for component testing and for inspection/maintenance programs. These procedures were validated on six light-duty vehicles.

34256 **(PB—86-156882/XAB) Gas-chromatographic method for quantitative determination of C2 to C13 hydrocarbons in roadway-vehicle emissions.** Stump, F.D.; Dropkin, D.L. (Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab.). 1985. 8p. (EPA/600/J—85/254). NTIS, PC A02/MF A01.

A gas chromatographic system was used to quantitate more than 300 gas-phase hydrocarbons from background and roadside ambient air samples. Samples were simultaneously collected in Tedlar bags and on Tenax cartridges. Hydrocarbons from Tedlar bag-collected samples were quantitated on a gas chromatograph arranged in a dual-column configuration and equipped with a flame ionization detector. The C2 and C3 hydrocarbons were separated on a 5-m long stainless steel column packed with silica gel; C4 to C13 hydrocarbons were separated on a 125-m long glass capillary column containing 7.5% hydrophobic silica. A stainless steel hydrocarbon trap filled with untreated glass wool permitted the concentration of at least 4-L of sample at 70% relative humidity. This extends the detection limits for individual hydrocarbons to 15.0 parts per trillion carbon. A programmable valve controller maintained trap cooling during hydrocarbon concentration and thermally desorbed the hydrocarbons for gas chromatographic analysis.

34257 **(PB—86-156890/XAB) Characterization of emissions from vehicles using methanol and methanol-gasoline blended fuels.** Gabele, P.A.; Baugh, J.O.; Black, F.; Snow, R. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). 1985. 9p. (EPA/600/J—85/255). NTIS, PC A02/MF A01.

Exhaust and evaporative emissions were examined from vehicles fueled with methanol or a gasoline-methanol blend. Regulated automobile pollutants, as well as detailed hydrocarbons, methanol, and aldehydes were measured, and exhaust emission trends were obtained for vehicle operation over five different driving cycles. Results indicated that use of the blended fuel does not generally have any significant effect on base-line exhaust emission rates of regulated pollutants; however, emission rates of aldehydes increased during the Federal Test Procedure. Aldehyde emissions from the methanol-fueled car were roughly an order of magnitude higher than those resulting from blended fuel usage. The hydrocarbon composition of evaporative emissions with the blended fuel was similar to that with the base-line fuel except when canister breakthrough occurred. Evaporative emissions during breakthrough were chiefly comprised of N-butane.

3308 Alternative Fuels

REFER ALSO TO CITATION(S) 34248

34258 (ORNL/TM—10009) Federal methanol fleet status, January 1986. McGill, R.N. (ed.). (Oak Ridge National Lab., TN (USA)). May 1986. Contract AC05-84OR21400. 17p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86011292.

This report presents the status of the Federal Methanol Fleet Project as of January 1986. A methanol fleet was established on November 1, 1985, at Lawrence Berkeley Laboratory in Berkeley, California. Phase I activities of the Army Methanol-Fueled Administrative Vehicle Program, involving four security vehicles at the Presidio in San Francisco, have been completed; and Phase II, in which 24 vehicles will be used at Fort Ord, California, is well underway. House bill H.R. 3355 has been introduced to promote greater use of methanol as a transportation fuel. It has been proposed that methanol is the best solution to the US oil import vulnerability.

34259 Superheated fuel injection for combustion of liquid-solid slurries. Robben, F. A. (to The United States of America as represented by the United States Department of Energy). US Patent 4,558,664. 17 Dec 1985. Filed date 19 Oct 1984. vp.

PAT-APPL-662658.

A method and device for obtaining, upon injection, flash evaporation of a liquid in a slurry fuel to aid in ignition and combustion. The device is particularly beneficial for use of coal-water slurry fuels in internal combustion engines such as diesel engines and gas turbines, and in external combustion devices such as boilers and furnaces. The slurry fuel is heated under pressure to near critical temperature in an injector accumulator, where the pressure is sufficiently high to prevent boiling. After injection into a combustion chamber, the water temperature will be well above boiling point at a reducted pressure in the combustion chamber, and flash boiling will preferentially take place at solid-liquid surfaces, resulting in the shattering of water droplets and the subsequent separation of the water from coal particles. This prevents the agglomeration of the coal particles during the subsequent ignition and combustion process, and reduces the energy required to evaporate the water and to heat the coal particles to ignition temperature. The overall effect will be to accelerate the ignition and combustion rates, and to reduce the size of the ash particles formed from the coal.

36 MATERIALS

3601 Metals And Alloys

REFER ALSO TO CITATION(S) 33549, 33549, 33549, 33646, 33799, 33807, 33952, 33953, 33985, 33987, 33994, 34000, 34003, 34025, 34069, 34118, 34535, 34536, 34584, 34731, 34732, 35379

34260 (AD-A—163918/6/XAB) Magnetization process in devitrified glassy alloy. O'Handley, R.C.; Megusar, J.; Sun, S.W.; Hara, Y.; Grant, N.J. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Materials Science and Engineering). 15 Apr 1985. 4p. NTIS, PC A02/MF A01.

Co84Nb10B6 metallic glasses have been devitrified so as to produce a series of specimens with increasingly coarser microstructure. Samples annealed for 1 h at Ta < or = 700 C remain largely glassy with a distribution of fine cobalt precipitates. Their coercivities increase with mean precipitate diameter. Samples annealed for 1 h at Ta > or = 700 C are fully crystallized (fcc Co plus a Co-Nb boride). Their coercivities decrease with increasing mean grain size. An abrupt increase in coercivity occurs between Ta = 650 and 700 C. Keywords: magnetic properties; amorphous magnetic alloys.

34261 (AD-A—164082/0/XAB) Life prediction for a structural material under cyclic loads with hold times using a viscoplastic constitutive model. Final report, 1 February 1983-31 January 1984. Eftis, J.; Jones, D.L. (George Washington Univ., Washington, DC (USA). School of Engineering and Applied Science). 31 Dec 1984. 127p. NTIS, PC A07/MF A01.

This investigation demonstrates the ability of the Chaboche viscoplastic constitutive theory to model the behavior of Ti-6Al-4V alloy at non-elevated temperature. The range of material behavior considered includes uniaxial monotonic stress-strain primary creep, stress relaxation, kinematic and isotropic hardening (and softening) under cyclic loading with and without hold times. The six materials parameters of the viscoplastic theory were evaluated from a series of strain-controlled stabilized cyclic loading tests, and room temperature primary creep tests. The viscoplastic strain calculations were integrated into a fatigue life prediction methodology for low cycle fatigue. Two sets of low cycle fatigue life predictions were carried out and compared with experimental data. One involved strain-controlled cyclic loading without hold times, and the other stress-controlled cyclic loading with hold times. Good agreement was found between predicted and actual results.

34262 (AD-A—164158/8/XAB) Synthesis and properties of elevated temperature p/m aluminum alloys. Final report, 1 October 1981-30 September 1985. Fine, M.E.; Weertman, J.R. (Northwestern Univ., Evanston, IL (USA). Dept. of Materials Science and Engineering). 30 Nov 1985. 114p. NTIS, PC A06/MF A01.

The microstructure of the aluminum base-iron-cerium and iron-molybdenum-vanadium alloys, developed for use up to 316C, is not stable at 425C (three-quarters of the absolute melting temperature of aluminum). Metastable dispersed phases are replaced by stable phases and particles of these coarsen rather rapidly with time. Creep loading accelerates these processes. Trialuminum-zirconium was predicted to be a preferable dispersed phase for strengthening aluminum for the 425 C temperature range because of good lattice matching with the aluminum matrix giving a low interfacial energy. This is true for the thermodynamically stable tetragonal phase but especially true for the metastable cubic phase. Dilute alloys were prepared by arc melting and these were aged to form precipitate dispersed phases. Substitution of vanadium for zirconium improved the lattice parameter matching for both cubic and tetragonal trialuminum-zirconium as well as increasing the stability of the cubic form. The coarsening rates of the particles at 425 C were 100 to 1000 times slower than for the aluminum-iron-cerium or molybdenum alloys, the aluminum-zirconium-vanadium alloy being better than the binary aluminum-zirconium alloy in this respect. These alloys are very promising as the basis for better high-temperature aluminum alloys.

34263 (CONF-860594—4) Weldability of an Ni_3Al alloy. Santella, M.L.; David, S.A.; Horton, J.A. (Oak Ridge National Lab., TN (USA)). 1986. Contract AC05-84OR21400. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011510.

From ASM international trends in welding research meeting; Gatlinburg, TN, USA (18 May 1986).

Since joining by conventional welding processes is an important means of fabricating structural components, weldability has become a key issue in the development of these new Ni_3Al alloys. Results of an initial evaluation of the weldability of Ni_3Al containing 0.1 at. % B and 0.5 at. % Hf are reported. Plates were prepared by conventional methods and used to make full penetration electron beam and gas tungsten arc welds. Initial results indicate that hafnium improves the weldability of Ni_3Al alloys although they are still susceptible to cracking. Examination of microstructures indicated that a distinct microsegregation pattern developed in the welds and affected the ordering behavior of fusion zones. Room temperature tensile testing suggested that welds can have strength and ductility values comparable to base materials, and that postweld heat treatment can improve tensile properties.

34264 **(CONF-860722—4) Finite element fracture analysis on a microcomputer.** Bryson, J.W.; Bass, B.R. (Oak Ridge National Lab., TN (USA)). 1986. Contract AC05-84OR21400. 20p. NTIS, PC A02/MF A01 - GPO. File Number TI86006214.

From ASME pressure vessel and piping conference and exhibit; Chicago, IL, USA (20 Jul 1986).

The ORVIRT.PC microcomputer program enables one to perform finite element fracture analysis on either an IBM PC/AT or PC/XT. When used together with its companion automatic mesh generation program, ORMGEN.PC, a complete fracture analysis consisting of mesh generation, stress analysis, and fracture analysis can typically be performed in 30 to 45 minutes. ORVIRT.PC is a stand-alone finite element program with the capability to carry out two-dimensional linear thermoelastic stress and fracture-mechanics analyses. Eight-noded isoparametric quadrilateral elements are employed everywhere in the modeling. Special quarter-point elements are used at the crack tip that provide the appropriate inverse square root variation in the near tip stress and strain fields. ORVIRT.PC utilizes a virtual crack extension technique that has been modified to include thermal strains. While this approach reduces identically to the J-integral for 2-D problems, it offers an advantage in application and programming effort over the latter when thermal loadings are considered. Sample problems are provided demonstrating that an accuracy better than 1% can be obtained with ORVIRT.PC. System requirements are an IBM PC/AT or PC/XT, 512K minimum memory, hard disk, math coprocessor, and IBM Professional Fortran Compiler. 14 refs., 5 figs.

34265 **(DOE/ER/10814—12) Zero-flux planes, flux reversals and diffusion paths in ternary and quaternary diffusion.** Dayananda, M.A. (Purdue Univ., Lafayette, IN (USA). School of Materials Engineering). 23 May 1986. Contract AC02-81ER10814. 36p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86011456.

During isothermal multicomponent diffusion, interdiffusion fluxes of individual components can go to zero at zero-flux planes (ZFP) and exhibit flux reversals from one side to the other of such planes. Interdiffusion fluxes as well as the locations and compositions of ZFPs for components are determined directly from the concentration profiles of diffusion couples without the need for prior knowledge of interdiffusion coefficients. The development and identification of ZFPs is reviewed with the aid of single phase and two-phase diffusion couples investigated in the Cu-Ni-Zn system at 775°C. ZFP locations in the diffusion zone nearly correspond to sections where the activity of a component is the same as its activity in either of the terminal alloys of a couple. Path slopes at ZFPs are uniquely dictated by the atomic mobility and thermodynamic data for the components. Discontinuous flux reversals for the components can also occur at interfaces in multiphase couples. Identification of ZFPs is also presented for diffusion in the Cu-Ni-Zn-Mn quaternary system. Analytical representation of diffusion paths for both ternary and quaternary diffusion couples is presented with the aid of characteristic path parameters.

34266 **(DOE/ER/10814—13) Estimation of diffusion path slopes at zero flux plane compositions.** Venkatasubramanian, R.; Dayananda, M.A. (Purdue Univ., Lafayette, IN (USA). School of Materials Engineering). 1985. Contract AC02-81ER10814. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011455.

A zero-flux plane (ZFP) for component i is a plane where the interdiffusion flux of the component goes to zero within the diffusion zone of a multi-component diffusion couple. ZFPs develop due to diffusional interactions among the diffusing species and have been identified in several ternary systems, such as Cu-Ni-Zn, Fe-Ni-Al and Cu-Ag-Au. In this paper a relation for the estimation of the slopes of diffusion paths at ZFP compositions in terms of thermodynamic data and atomic mobilities is derived and is utilized in calculating the diffusion path slopes for several couples in the Cu-Ni-Zn ternary system.

34267 **(DOE/ER/10814—14) Diffusion path representation for two-phase ternary diffusion couples.** Dayananda, M.A.; Venkatasubramanian, R. (Purdue Univ., Lafayette, IN (USA). School of Materials Engineering). 1986. Contract AC02-81ER10814. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011454.

Several two-phase, solid-solid diffusion couples from diffusion studies in the ternary Cu-Ni-Zn, Fe-Ni-Al and Cu-Ag-Au systems were investigated for their analytical representation on the basis of characteristic path parameters. The concentration profiles were examined in terms of relative concentration variables for cross-over compositions and internal consistency. The diffusion paths delineated single or double S-shaped curves crossing the straight line joining the terminal alloy compositions once or thrice. Cross-over compositions were identified in the individual phase regions or at an interface. Based on the symmetry between the path segments on either side of cross-over compositions, the paths were analytically represented with the aid of cross-over compositions and path slopes at these compositions, considered as path parameters. Exprestion for the ratios of diffusion depth on the two sides of the Matano plane were derived in terms of cross-over compositions and the estimated ratios of diffusion depths were found to be consistent with those observed from the concentration profiles.

34268 **(DOE/ER/10814—15) Interdiffusion in the Ni-Cr-Co-Mo system at 1300°C.** Heaney, J.A. III; Dayananda, M.A. (Purdue Univ., Lafayette, IN (USA). School of Materials Engineering). 1985. Contract AC02-81ER10814. 30p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86011453.

Interdiffusion was investigated with solid-solid diffusion couples in the α (fcc) region of the quaternary Ni-Cr-Co-Mo system at 1300°C for the determination of diffusion paths and diffusional interactions among the components. The concentration profiles for a given couple exhibited a common cross-over composition, Y/sub c/, which reflected the relative depths of diffusion in the terminal alloys. Interdiffusion fluxes were calculated directly from the concentration profiles and the quaternary interdiffusion coefficients were calculated at selected compositions. Ni and Co exhibited uphill diffusion against their individual concentration gradients in a direction opposite to the interdiffusion of Cr. Quaternary diffusion paths were presented as a set of partial diffusion paths on the basis of relative concentration variables.

34269 **(DOE/ER/10814—16) Zero-flux planes and flux reversals in multicomponent diffusion. Final report.** Dayananda, M.A. (Purdue Univ., Lafayette, IN (USA). School of Materials Engineering). 31 May 1986. Contract AC02-81ER10814. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86011452.

This progress report covers the fifth and final year of operation under Contract DE-AC02-81ER-10814. The principal area of research during the contract period has been interdiffusion in multicomponent alloys for the development of zero-flux planes and flux reversals, diffusion paths and diffusion structures, and analytical representation of diffusion paths for ternary, quaternary and quinary diffusion couples. The systems investigated are: Cu-Ni-Zn, Fe-Ni-Cr, Cu-Ni-Zn-Mn, Ni-Co-Cr-Mo and Ni-Co-Cr-Fe-Mo systems. A brief general review of the research contributions during the contract period is also given. During this final year of operation of the agreement, the research emphasis has been on the representation of diffusion paths for both single phase and two-phase diffusion couples with 3 to 5 components (three projects).

34270 **(DOE/ER/45074—T1) Evidence for internal dissociation during the oxidation of nickel metal.** Sankaran, S.; MacCrone, R.K.; Shatynski, S.R. (Rensselaer Polytechnic Inst., Troy, NY (USA). Dept. of Materials Engineering). 23 Apr 1986. Contract FG02-84ER45074. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011176.

Magnetic resonance measurements on thermally grown NiO show discrete regions of nickel metal embedded in the oxide under certain conditions. The results of a detailed thermogravimetric study, magnetic resonance measurements and morphology of the oxides grown on nickel strips ground to surface finishes of 0.3μm

to 50μm are presented and it is shown that the surface roughness prior to oxidation has a dominating effect. The oxidation of the samples were carried out in 10^6Pa oxygen at 1273°K for 2 to 16 hours. For a critical metal roughness of ≃20 μm, the oxidation kinetics approach Wagnerian prediction and the resonance intensity shows a maximum; these features are also accompanied by changes in the oxide morphology. It is proposed that deadhesion of the oxide at the oxide/metal interface caused by geometrical constraints takes place, and that the subsequent anisotropic dissociation of the oxide is responsible for the metallic regions. At the same time, the nonideal morphology gives rise to kinetics close to the ideal.

34271 (DOE/ER/45094—T1) Critical field measurements on very thin films of V-Ga superconductors. Tkaczyk, J.E.; Tedrow, P.M. (Massachusetts Inst. of Tech., Cambridge (USA). Francis Bitter National Magnet Lab.). 1985. Contract FG02-84ER45094. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010772.

V_3Ga thin films, 500, 20, 10 and 8 nm thick have been made for the purpose of studying the role of spin-orbit scattering in the theory of high field superconductivity. Either 1% dopings or thin layers of high-atomic-number elements have been added to these samples in an attempt to increase the spin-orbit scattering rate in this paramagnetically limited material. Critical fields are presented and material parameters are obtained by fitting to a modified Werthamer-Helfand-Hohenberg (WHH) theory. The uniqueness of the parameters obtained in this manner is discussed in light of Fermi-liquid effects. Comparisons are drawn with bulk V_3Ga.

34272 (DOE/ER/45181—2) Microstructural effects on the fatigue behavior of Fe-C-X alloys. Summary progress report. Shiflet, G.J. (Virginia Univ., Charlottesville (USA). Dept. of Materials Science). Apr 1986. Contract FG05-85ER45181. 68p. (UVA—527315/MS86/101). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86010918.

This document reports on an Fe-C-Mn steel similar to the one examined by Suzuki and McEvily. This alloy was used to investigate the interaction between phase continuity and deformation behavior, with special interest on dislocation interactions. The microstructural variations examined were also used to test the model of fatigue crack growth rates developed by Chakrabortty. Two Fe-C-Mo alloys are also reported on. In these steels the relationship between ferrite, martensite and carbides is carefully controlled. As Mo has a large negative Wagner interaction parameter, copious amounts of Mo_2C carbides in conjunction with ferrite are produced. By controlling temperature, the carbide morphology in these alloys can be altered and by controlling composition, the density of Mo_2C can be changed.

34273 (DOE/OR/00033—T178) Laser driven micro-explosive bonding. Alexander, D. (Michigan Univ., Ann Arbor (USA). Dept. of Nuclear Engineering). Feb 1986. Contract AC05-76OR00033. 52p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86010837.

This experiment demonstrated the ability of the LEM process to bond micron thick films of Al to both Cu and Si substrates. Bonding was observed for laser intensities ranging from 1.0 - 9.0 x 10^9W/cm^2.

34274 (EGG-M—0885) Crack embrittlement displacement fields. Epstein, J.S.; Reuter, W.G.; Keiser, D.D. (Idaho National Engineering Lab., Idaho Falls (USA)). 1986. Contract AC07-76ID01570. 23p. (CONF-8510237—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011036.

From DOE symposium on engineering energy sciences; State College, PA, USA (11 Oct 1985).

When using precracked fracture toughness specimens to study liquid metal embrittlement it has been necessary to estimate the crack length and applied load as a function of time. These parameters are sometimes difficult to obtain and the accuracy is often questionable. Further this data provides the basis for calculating crack growth rate (da/dt) as a function of applied stress intensity factor K/sub I/. This paper presents an approach based on using moire interferometry in conjunction with fracture toughness specimens to study liquid mercury amalgam embrittlement of 6061-T6 aluminum. Moire interferometry provides a unique method for obtaining K/sub I/, at the crack tip, without requiring knowledge of crack length and load. This paper describes the approach and provides an evaluation based on test results.

34275 (GA-A—18430) Thermal history of HT-9 weldment heat-affected zones during welding. Foulds, J.R. (GA Technologies, Inc., San Diego, CA (USA)). Apr 1986. Contract AC03-84ER53158. 22p. (CONF-860421—48). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010684.

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

HT-9, a commercial 12Cr-1Mo ferritic steel, is a candidate structural material for fusion reactor first walls. The microstructure in weldments of this material has been observed to vary over short distances as a function of the varying thermal history during welding. An example is the observation of several heat-affected zones over less than a 2.5 mm (0.1 in.) distance from the weld/base metal interface. The mechanical behavior response of "local" weldment microstructures can be characterized by simulation of the structure over larger usable volumes of material. This requires precise knowledge of the "local" thermal history during welding. An empirical equation for describing the thermal history of HT-9 weldment heat-affected zones during gas tungsten-arc welding is presented in this paper. Both peak temperatures and cool-down cycles, are predictable at any location in the base metal heat-affected zone for welding of plate under heat flow conditions similar to those anticipated for first wall component fabrication, i.e., two-dimensional heat flow. Power input and preheat effects are included in the equation.

34276 (INIS-BR—461, pp 58-60) Cutting of thin sample to study the irradiation damage. Abreu, A.S. de; Goncalves, Z.C. 1984. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. File Number DE86702106.

In Annual technical report of Nuclear Engineering Institute - Physics Department - 1984.

34277 (Juel—2019) Studies on the creep ratcheting behaviour of tube specimens. Zottmaier, R.; Over, H.H.; Schubert, F.; Nickel, H. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung). Sep 1985. 168p. (In German). NTIS (US Sales Only), PC A08/MF A01. File Number DE86752050.

By superimposing cyclic secondary stresses sigmasub(T) additionally to a constant primary stress sigmasub(p), significant enhanced creep rates of structural components at very high temperatures may be the result. This effect is known as 'Creep Ratcheting' or 'Incremental Growth'. It may occur due to cyclic variations of thermal stresses in the walls of heat exchanger - or chemical reformer-tubes for example. The creep ratcheting effect was evaluated experimentally by comparing the creep behaviour of metallic tube specimens under constant axial load P with and without superimposed cyclic thermal stresses across the tube wall. For theoretical analysis a numerical computer programme has been developed. The tests on lead specimens at temperatures of up to 100°C and on the high temperature alloy X10 NiCrAlTi 32 20 H of up to 950°C showed no significant enhanced stationary creep rates for the [illegible] relations sigmasub(T) / sigmasub(p) < 2. For high secondary stresses (sigmasub(T) / sigmasub(p) > 2) the creep rate increased up to a factor of 15 compared to the creep behavior with the same primary stress as the only effective load. The results of the numerical computer programme developed for this paper and of a Finite Element Analysis showed good consistency with the experimental data only when the temperature dependence of the stationary creep rate and the shape of the time-temperature cycles of the thermal load variations were considered. (orig.).

34278 (Juel-Conf—54, pp 445-454) Corrosion behaviour of unalloyed steel and cast iron in groundwaters of the bedrock of Northern Switzerland. Simpson, J.P.; Knecht, B. (Sulzer Bros. Ltd., Winterthur, Switzerland; Nationale Genossenschaft zur Lagerung Radioaktiver Abfaelle, NAGRA, Baden, Switzerland). Jun 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE86752037. (CONF-8506114—).

From International seminar on radioactive waste products suitability for final disposal; Julich, F.R. Germany (10 Jun 1985).

The corrosion behaviour of both materials is essentially the same in the two water compositions investigated. No significant effect of the bentonite on the corrosion behaviour could be detected. The corrosion rate decreases rapidly over the first 500 hours; after that time the corrosion rate settles to values difficult to determine accurately, but estimated to be less than 10 μm/a both at 80°C and 140°C. Localized attack was not observed. It is concluded that a corrosion allowance of 20 mm is adequate to ensure a life of 1,000 years for cast steel and cast iron under repository conditions close to the test conditions.

34279 **(KFK—3397) Creep rupture tests and microstructure investigations on the SNR-300 structural material X6CrNi 1811 (DIN 1.4948) in the frame of the 'Extrapolation Program'. Final report.** Schirra, M.; Ehrlich, K.; Gross, R.; Seith, B.; Solano, R.R.; Rivas, M. de las; Barroso, S. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung; Junta de Energia Nuclear, Madrid (Spain)). May 1985. 158p. (In German). NTIS (US Sales Only), PC A08/MF A01. File Number DE86752045.

The austenitic stainless steel X6CrNi 1811 (DIN 1.4948) which is used as a structural material for the German Fast Breeder Reactor SNR 300 was creep-tested in a temperature range of 550-750° under base material condition and as welded material. The results of the creep rupture strength and creep behaviour up to >= 30 000 hrs support experimentally the extrapolation up to operating times >= 10^5 hours. The microstructure in the basic material of the broken test-specimens was studied by light and transmission electron microscopy and partly evaluated in a quantitative form. All precipitates found at the grain boundaries and inside the grains belong to the type $M_{23}C_6$. Their nucleation is bound to the defects of the crystal lattice and hence depends on the configuration and movement of the dislocations. Therefore a mutual correlation between the creep process and the nucleation of precipitates exists. This explains the divergence of the plot log epsilonsub(min) vs. log sigmasub(o) from a straight line and influences the ductility values. The precipitates at the grain boundaries, which nucleate in competition with the matrix precipitates favour the intercrystalline rupture. (orig.).

34280 **(KFK—3917) Reaction kinetics of Zircaloy-4 in a 25% O_2/75% Ar gas mixture from 900 to 1500°C under isothermal conditions.** Uetsuka, H.; Hofmann, P.; Burbach, J.; Metzger, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Nukleare Sicherheit). May 1985. 53p. NTIS (US Sales Only), PC A04/MF A01. File Number DE86752043.

The reaction kinetics of Zircaloy-4 in oxygen and argon were determined by isothermal oxidation tests of cladding specimens at temperatures from 900 to 1500°C for times between 2 and 60 minutes. In this temperature range the oxidation reaction obeys a parabolic rate law. A discontinuity in the temperature dependence of the reaction rate was observed between 1000 and 1100°C, which may be attributed to an allotropic phase transformation of the ZrO_2. The equations describing the temperature dependence of the parabolic rate constants for mass increase, ZrO_2 oxide layer growth and (ZrO_2 + α-Zr(0)) double layer growth were determined. No significant difference was seen between the oxidation rate equations obtained in the present study and those obtained in the Zircaloy-4/steam oxidation experiments. Changing the oxygen concentration in the gas mixture from 10 to 100 vol% does not affect the oxidation kinetics of Zircaloy-4. Finally, an evaluation was made of the temperature measured in the MONA experiments (UO_2/Zircaloy-4 interaction experiments under oxidizing conditions) using the reaction kinetics for oxide layer growth obtained in the present experiments. The comparison of the ZrO_2 oxide layer thickness for certain time-temperature curves shows that the temperatures in the MONA tests determined, using a pyrometer, were 25 to 70°C below the actual test temperature in the temperature range from 1000 to 1400°C. (orig.).

34281 **(KFK—3918) Parameter study of the corrosion behaviour of welding joints combining various austenitic stainless steels in boiling 65% nitric acid (Huey-Test).** Schneider, M.; Kraft, R. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung). Oct 1985. 88p. (In German). (PWA—34/85). NTIS (US Sales Only), PC A05/MF A01. File Number DE86752044.

As part of the corrosion testing of numerous austenitic CrNi-steels as appropriate materials for nuclear reprocessing purposes welding samples, made of various matrix and welding filler materials, have been subjected to corrosion testing under ASTM Standard Huey-Test conditions. The tested matrix materials were austenitic steels of type Cr18Ni10, Cr25Ni20 and Cr17Ni14Si4, the tested welding filler materials were austenitic steels of type Cr18Ni10, Cr25Ni20 and Cr29Ni36. The following parameters were modified: producer, chemical composition, heat treatment, weld shape and rolling direction of the sheet metal. The influence of welding on corrosion behaviour was investigated with respect to the welding joint as a whole, the matrix materials, the welding filler materials and the heat affected zone (HAZ). The rate of metal loss was determined by gravimetry, the depth of local dissolution was checked by metallography, and both were evaluated as corrosion data. The resulting corrosion behaviour of matrix materials was not affected by the process of welding and the combination with welding filler materials. Corrosion data confirm results of recent investigations on unwelded samples. After welding, the welding filler materials are better resistant against intergranular corrosion than all matrix materials. Their behaviour is unfavourably influenced by matrix materials with high corrosion rates. With decreasing contents of chromium and nickel the resistance against intergranular corrosion also decreases. Within the heat affected zones (HAZ) there is no accelerated intergranular corrosion caused by the applied heat treatment. (orig./IHOE).

34282 **(LA-UR—86-1581) Modeling a hydroform springback problem.** Korzekwa, D.A.; Guerra, F.M. (Los Alamos National Lab., NM (USA)). 1986. Contract W-7405-ENG-36. 34p. (CONF-860590—2). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86011260.

From Symposium on computer modeling of fabrication processes and constitutive behavior of metals; Ottawa, Canada (15 May 1986).

A shallow stretch - draw sheet forming operation performed on a hydroform machine was modeled with the finite element codes NIKE2D and ADINA78. The forming process produces a a thin spherical shell segment with a flange. The final shape of the part differs substantially from the die because of springback, yet the part must be very accurate to meet the specified tolerance. This difficult problem was chosen specifically to determine the limits of accuracy of currently available codes. NIKE2D produced reasonably good results on a macroscopic scale. However, the strain predictions were not quantitatively correct, and the shape predictions were not accurate enough to predict whether the part would satisfy the very restrictive tolerance. The ADINA results were similar. The experimental results strongly suggest that the friction conditions at the flange are not being modeled accurately, which results in the inaccurate strain predictions. The springback predictions were qualitatively correct, indicating that improvements in the predicted strains should give much better shape predictions.

34283 **(ORNL—6274) Alloy design criteria and evaluation methods for advanced austenitic alloys in steam service.** Swindeman, R.W.; Goodwin, G.M.; Maziasz, P.J.; Judkins, R.R.; DeVan, J.H. (Oak Ridge National Lab., TN (USA)). May 1986. Contract AC05-84OR21400. 43p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86011341.

Design criteria and evaluation methods are identified for austenitic alloys that are needed for steam service at 650°C and 35 MPa. The design criteria are separated into five categories: metallurgical stability; fabrication and joining; mechanical properties; fireside corrosion resistance; and steamside corrosion resistance. In each category alloys that have potential for meeting the design criteria are identified, and methods are outlined for evaluating com-

mercial and developmental alloys against the criteria. Alloys falling into the austenite phase field at 650°C are potentially the most stable, and the lean stainless steels typified by 17-14 Cu/Mo stainless steel appear to have adequate strength and fabricability. Such steels need to be protected from corrosive media by cladding or surface treating. Alloys such as 800H have adequate fabricability and steamside corrosion resistance but need improvements in strength and stability. High-chromium steels are best for fireside corrosion resistance but need to be stabilized by large nickel additions. Research efforts are outlined to improve the corrosion resistance of tubing fabricated from lean stainless steels and to improve the strength of high-chromium alloys. When the evaluation is completed in 1990 a basis will be provided for the selection of the best alloy for subsequent commercialization. 59 refs., 4 figs.

34284 **(ORNL/TM—10049) Design, construction, and initial results for an erosion-corrosion test system.** Keiser, J.R. (Oak Ridge National Lab., TN (USA)). May 1986. Contract AC05-84OR21400. 24p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86011291.

Erosion and erosion-corrosion are among the most serious forms of material degradiation encountered in coal conversion and combustion systems. To improve our understanding of such phenomena, a unique system has been constructed to perform erosion and erosion-corrosion studies in a specially modified scanning electron microscope. This microscope incorporates a gun that shoots erosive particles at a target specimen and also a hot stage that can heat both the test specimen and a corrosive gas directed onto the specimen surface. Intial results show that the system is capable of novel studies or erosion and erosion-corrosion, which should lead to improved understanding of those degradation modes. 8 refs., 9 figs.

34285 **(PNL—5426) Corrosion and environmental-mechanical characterization of iron-base nuclear waste package structural barrier materials. Annual report, FY 1984.** Westerman, R.E.; Haberman, J.H.; Pitman, S.G.; Pulsipher, B.A.; Sigalla, L.A. (Pacific Northwest Labs., Richland, WA (USA)). Mar 1986. Contract AC06-76RL01830. 132p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE86010856.

Disposal of high-level nuclear waste in deep underground repositories may require the development of waste packages that will keep the radioisotopes contained for up to 1000 y. A number of iron-base materials are being considered for the structural barrier members of waste packages. Their uniform and nonuniform (pitting and intergranular) corrosion behavior and their resistance to stress-corrosion cracking in aqueous environments relevant to salt media are under study at Pacific Northwest Laboratory. The purpose of the work is to provide data for a materials degradation model that can ultimately be used to predict the effective lifetime of a waste package overpack in the actual repository environment. The corrosion behavior of the candidate materials was investigated in simulated intrusion brine (essentially NaCl) in flowing autoclave tests at 150°C, and in combinations of intrusion/inclusion (high-Mg) brine environments in moist salt tests, also at 150°C. Studies utilizing a ^{60}Co irradiation facility were performed to determine the corrosion resistance of the candidate materials to products of brine radiolysis at dose rates of 2×10^3 and 1×10^5 rad/h and a temperature of 150°C. These irradiation-corrosion tests were "overtests," as the irradiation intensities employed were 10 to 1000 times as high as those expected at the surface of a thick-walled waste package. With the exception of the high general corrosion rates found in the tests using moist salt containing high-Mg brines, the ferrous materials exhibited a degree of corrosion resistance that indicates a potentially satisfactory application to waste package structural barrier members in a salt repository environment.

34286 **(PNL-SA—13349) Measurement and prediction of thermochemical history effects on sensitization development in austenitic stainless steels.** Bruemmer, S.M.; Charlot, L.A. (Pacific Northwest Labs., Richland, WA (USA)). Nov 1985. Contract AC06-76RL01830. 26p. (CONF-860304—8). NTIS, PC A03/MF A01. File Number TI86011324.

From Corrosion '86; Houston, TX, USA (17 Mar 1986).

The effects of thermal and thermomechanical treatments on sensitization development in Type 304 and 316 stainless steels have been measured and compared to model predictions. Sensitization development resulting from isothermal, continuous cooling and pipe welding treatments has been evaluated. An empirically modified, theoretically based model is shown to accurately predict material degree of sensitization (DOS) as expressed by the electrochemical potentiokinetic reactivation (EPR) test after both simple and complex treatments. Material DOS is also examined using analytical electron microscopy to document grain boundary chromium depletion and is compared to EPR test results.

34287 **(SAND—85-2521C) Weldability, microstructure and properties of precipitation strenghtened martensitic stainless steels.** Brooks, J.A.; Cieslak, W.R.; Garrison, W.M. Jr. (Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 25p. (CONF-860594—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010955.

From ASM international trends in welding research meeting; Gatlinburg, TN, USA (18 May 1986).

We have investigated the influence of welding on the mechanical properties and corrosion resistance of two precipitation strengthened martensitic stainless steels: Custom 450 and PH 13-8 Mo. The two alloys exhibited very good weld cracking resistance, although the formation of a low melting NbC eutectic constituent did cause some solidification cracking in Custom 450. The effects of aging temperature on tensile and impact properties were similar in the base metal and Gas-Tungsten-Arc (GTA) weldment for both alloys. The similarity of weld and base metal properties is attributed to the uniform precipitate distribution throughout the weld, as shown by Transmission Electron Microscopy (TEM) and electron microprobe analyses. The susceptibility to pitting corrosion was not impaired by aging or by welding, with the possible exception of a narrow band in the heat-affected zone (HAZ), and both materials were more resistant than 304 stainless steel. The narrow band is identified by electrochemical reactivation testing as a region of increased matrix activity likely caused by localized Cr and/or Mo depletion.

34288 **(SAND—85-8247) Compositional and microstructural effects on hydrogen embrittlement of ASTM grade 12 titanium (TI 0.3 Mo - 0.8 Ni).** Moody, N.R.; Robinson, S.L. (Sandia National Labs., Livermore, CA (USA)). May 1986. Contract AC04-76DR00789. 41p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86011379.

This study characterized the effects of alloy composition, microstructure, and hydrogen on ASTM grade 12 titanium tensile properties and fracture. The effect of alloy composition on the tensile properties agreed with previous studies. Mo, Fe, and O each increased the yield and ultimate tensile strengths and the fracture stress in all heats studied. Ni had little effect on the yield and ultimate strengths but decreased the fracture stress. Mo and Fe increased ductility, whereas, Ni and O decreased it. In contrast, hydrogen increased the ultimate tensile strength but decreased the yield strength, fracture stress and ductility. The decrease in properties was independent of alloy composition. However, the amount of hydrogen-induced secondary cracking exhibited significant heat-to-heat variation which was directly related to the microstructure. Alloy heats with a well-defined banded microstructure and significant amount of intergranular β exhibited more hydrogen-induced secondary cracking than alloy heats with poorly-defined banded microstructures or less intergranular β. These results showed that grade 12 titanium used for high-level nuclear waste storage applications should have the lowest total concentration of alloying elements required to provide adequate toughness and corrosion resistance. The alloy should also be fully annealed to reduce the severity of microstructural banding and the amount of intergranular β. The low concentration of alloying elements and a full anneal will reduce susceptibility to hydrogen embrittlement.

34289 **(TVA/PE/EDT—85/25) Microstructural and microchemical investigation of irradiated pressure vessel steel weld metal from H.B. Robinson II and Rolls Royce. Final report.** Brenner, S.S.; Burke, M.G. (Pittsburgh Univ., PA (USA). Dept. of Metallurgical and Materials Engineering). 31 May 1985. 41p. NTIS, PC A03/MF A01. File Number DE86901138.

Field-ion microscopy and atom probe microchemical analysis have been employed to characterize the microstructure and solute redistribution in two irradiated steels which differed in Cu, Ni and Mn content. Neutron irradiation promoted the formation of clusters rich in Cu, Mn, and Ni in both steels. The results of this investigation provide important microstructural information concerning the role of Ni and Mn in irradiation-hardening of pressure vessel steel weld metals.

34290 **(UCRL—94351-Rev.1) Chemistry and shock initiation of intermetallic reactions.** Hardt, A.P.; McHugh, S.L.; Weinland, S.L. (Lockheed Palo Alto Research Labs., CA (USA); Lawrence Livermore National Lab., CA (USA)). 22 Apr 1986. Contract W-7405-ENG-48. 22p. (CONF-860739—3-Rev.1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010549.

From 11. international pyrotechnics seminar; Vail, CO, USA (7 Jul 1986).

Shock initiation of pyrotechnic mixtures is a relatively new discipline. In earlier studies, the estimation of the Hugoniots of porous mixtures had been described and application of experimental results to pyrotechnic mixtures was reported. In this investigation, the shocked reaction mixture was recovered in order to demonstrate that reaction took place. The mixture hafnium-platinum was chosen for its low thermal initiation threshold and highly exothermic reaction. Specimens were subjected to shock in a gas gun using aluminum fliers. The product was recovered from a steel catcher and examined by metallography. The initiation threshold in terms of flier velocity was predicted from the Herrmann P-α model and the initiation enthalpy. Although reacted material was clearly identified, the initiation threshold was not bracketed. The reaction product, Pt_3Hf, was characterized by density and metallography. Although shock was shown to compact the starting mixture, the product, after melting, contained a uniform distribution of micropores.

34291 **Deformation and fracture characteristics for irradiated Inconel X-750.** Mills, W.J.; Mastel, B. (Westington Hanford Company, Materials Applications, P.O. Box 1970, Richland, WA 99352). *Nuclear Technology;* 73: No. 1, vp(Apr 1986). Contract AC06-76FF02170.

Fast neutron irradiation to total fluences ranging from 7.7 x 10^{21} to 5.7 x 10^{22} n/cm^2 (3 to 16 dpa) resulted in a 65% increase in yield strength and a four-fold reduction in ductility. Intergranular fracture was the dominant failure mode for the irradiated material, whereas equal amounts of intergranular and transgranular cracking were found in the unirradiated condition. This fracture mechanism transition resulted from intense heterogeneous deformation in a matrix strengthened by an irradiation-produced dislocation substructure. Planar slip bands impinged on the grain boundaries causing very high local stresses. Intergranular cracking resulted because the hardened matrix prevented relaxation of the stress concentrations.

34292 **The early stages of tempering in a 3Cr-1.5Mo steel.** Todd, J.A. (Department of Materials Science, University of Southern California, Los Angeles, CA 90089-0241). *Scripta Metallurgica;* 20: No. 2, vp(Feb 1986).

In 1959 Baker and Nutting established that the carbides precipitated during the tempering of bainitic 2.25Cr-1Mo pressure vessel steels followed the sequence M_3C, Mo_2C, M_7C_3, $M_{23}C_6$ and M_6C. Titchmarsh and later Pilling and Ridley identified characteristic energy dispersive X-ray spectra for these carbides. Recent studies of the early stages of tempering in a 3Cr-1.5Mo steel have revealed a carbide, containing both chromium and molybdenum, which does not correspond to the above characteristic spectra. Convergent beam electron diffraction (CBED) and energy dispersive X-ray (EDX) analyses have been carried out to investigate the structure and composition of this carbide and also to study the change in tempering kinetics produced by additions of chromium and molybdenum to 2.25Cr-1Mo pressure vessel steels.

34293 **Site occupancy in solid solutions of Nb in the intermetallic compounds TiAl and Ti_3Al.** Konitzer, D.G.; Jones, I.P.; Fraser, H.L. (Department of Metallurgical Engineering and Materials Research Laboratory, University of Illinois, 1304 W. Green, Urbana, IL 61801). *Scripta Metallurgica;* 20: No. 2, vp(Feb 1986). Contract AC02-76ER01198.

Ti aluminides are receiving attention as potential candidates for elevated temperature applications. The compounds Ti_3Al and TiAl both exhibit reasonable strength at elevated temperatures but have limited ductilities at room temperature. In the case of Ti_3Al there appear to be two causes for this limited ductility: firstly, an inhomogeneous distribution of slip dislocations and secondly, a lack of a significant number of dislocations which have Burgers vectors with a c-component. It has been found that significant additions of Nb to Ti_3Al improve mechanical properties, both strength and ductility. These improvements have been attributed to an increase in the number of dislocations with Burgers vectors having c-component.

34294 **Determination of the composition of the icosahedral phase in rapidly solidified Al-Mn quasicrystals at high spatial resolution.** Krishnan, K.M.; Gronsky, R.; Tanner, L.E. (National Center for Electron Microscopy, Lawrence Berkeley Laboratory, University of California, Berkeley, CA 94720). *Scripta Metallurgica;* 20: No. 2, vp(Feb 1986). Contract AC03-76SF00098;W-7405-ENG-48.

Phenomenological models based on Landau theory with the point symmetry of the icosahedron and quasiperiodic or incommensurate translational order have been presented. These models accurately reproduce the observed diffraction patterns, but the position of the most intense peaks scale with tau^{-1} unlike the experiments where they scale with tau^{-3}. An alternative approach is to interpret the experimental data as a projection in three dimensions of a six-dimensional regular crystal. Katz and Duneau and independently, Elser have computed the diffraction pattern of a three-dimensional Penrose pattern using an elegant projection scheme from a higher dimensional periodic lattice. The find δ-function peaks that are dense in reciprocal space, where the most intense peaks not only account for the peak positions in the Al-Mn diffraction patterns but also scale as tau^{-3}. However, an understanding of the peak intensities is as yet non-existent, for this would entail a detailed knowledge of the distribution of the aluminum and manganese atoms in the quasilattice. In order to solve this problem, it is necessary to first determine the composition of the icosahedral phase as accurately as possible. This is complicated because the icosahedral phase is formed over a range of starting compositions (10-25 atom-percent manganese) and the microstructure is such that these grains with icosahedral symmetry typically reach an average diameter of only 1-2 microns and they are embedded in an aluminum-rich matrix phase. Preliminary studies suggest an average optimal manganese content of 22 at%. In this report, the authors present the first results of determination of the composition of the icosahedral phase by energy dispersive x-ray spectroscopy measurements using convergent electron probes.

34295 **Hall-Petch strengthening for the microhardness of twelve nanometer grain diameter electrodeposited nickel.** Hughes, G.D.; Smith, S.D.; Pande, C.S.; Johnson, H.R.; Armstrong, R.W. (University of Maryland, College Park, MD 20742). *Scripta Metallurgica;* 20: No. 1, vp(Jan 1986).

Hall-Petch strengthening has been observed for the microhardness of electrodeposited nickel extending to a grain diameter of approximately 12 nm. A microhardness value of approximately 7 kN/mm^2 (700 kg/mm^2) is obtained at this smallest grain size. Estimated Hall-Petch friction stress and stress intensity values for flow stress at $\epsilon = 0.075$ compare reasonably well with theoretical model calculations and previously reported tensile stress-strain measurements on related specimens.

34296 **An analytical electron microscopy study of the recently reported "Ti_2Al phase" in γTiAl alloys.** Kaufman, M.J.; Konitzer, D.G.; Shull, R.D.; Fraser, H.L. (National Bureau of Standards, Gaithersburg, MD 208999). *Scripta Metallurgica;* 20: No. 1, vp(Jan 1986). Contract AC02-76ER01198.

A variety of experimental techniques has been utilized to establish that the phase reported to be a new stable Ti_3Al phase is instead Ti_3AlN. The space group has been determined to be $P6_3/mmc$ with lattice parameters, a = 0.304 nm and c = 1.369 nm, in agreement with the results of Jeitschko, et al. Also, since this phase is observed only in alloys which do not contain α_2-Ti_3Al, it was suggested that the solubility of N in α_2 must be rather large, while that in the γ(TiAl) phase is low. In light of the improved creep properties of γ alloys containing Ti_3AlN precipitates, it is suggested that an increase in the volume fraction of this phase, by increasing the N and/or C contents, might be used to enhance the mechanical properties of this normally brittle compound.

34297 **The relationship of grain size to critical distance and hydrogen-induced crack growth thresholds.** Moody, N.R.; Stoltz, R.E.; Perra, M.W. (Sandia National Laboratories, Livermore, CA 94550). *Scripta Metallurgica;* **20**: No. 1, vp(Jan 1986). Contract AC04-76DP00789.

IN903 thresholds were found to increase as grain size increased at a constant yield strength. This leads to the conclusion that grain size establishes the minimum critical distance over which the fracture stress must be exceeded for cracking to occur. A first order normalization with respect to yield strength shows that the effect of grain size on thresholds for IN903 and 4340 was the same although they have different crystal structures. It was also shown that a local critical stress model with the critical distance assumed to be equal to the grain size and reasonable assumed fracture stress values predicts the lower limiting threshold behavior found in alloys such as 4340 at high yield strengths. However, at lower yield strengths the critical distance extends several grain diamters. Under these conditions, the critical distance is no longer equivalent to a basic microstructural dimension and is dependent on other material properties such as yield strength and fracture stress. As a consequence, use of the grain size as the critical distance for predicting sustained crack growth thresholds gives reasonable values at high yield strengths and conservative values at lower yield strengths. Accurate modelling of thresholds at lower yield strengths, particularly from a predictive standpoint, requires more theoretical and experimental work to define the relationship between the critical distance for sustained crack growth and material properties.

34298 **The influence of sulfide inclusions on the initiation of pits in Fe-29Ni-17Co.** Cieslak, W.R. (Sandia National Laboratories, P.O. Box 5800, Albuquerque, NM 87185). *Corrosion (Houston);* **42**: No. 2, vp(Jan 1986). Contract AC04-76DP00789.

Kovar sheet and rod samples were tested in the as-received (R/sub B/80 and R/sub B/95, respectively) condition. Pitting tests were conducted on three sheet orientations: face, long-transverse (side), and short-transverse (end) and on two rod orientations: cross section (end) and length. Samples were prepared for testing by grinding and chemically cleaning all faces, spot-welding a Kovar wire to the back, and mounting in Maraglas resin. The exposed face was ground with 600-grit SiC paper and rinsed in deionized water immediately before testing. The grinding scratches were aligned in the rolling direction of the sheet and the drawing direction of the rod length. All tests were conducted in a room temperature 0.5 M NaCl electrolyte adjusted to pH 10 by the addition of NaOH. Polarization of Kovar in nonalkaline 0.5 M NaCl did not yield a sharp pitting potential because of the lack of a stable passive potential region. The electrolyte was purged with N_2 during testing and for a minimum of 4 h before testing. Potentiodynamic tests were conducted from the open circuit potential, following 15-min immersion, at a potential scan rate of 6 mV/min. Critical pitting potentials are reported as the average of six measurements.

34299 **Composition-based correlations to predict sensitization resistance of austenitic stainless steels.** Bruemmer, S.M. *Corrosion (Houston);* **42**: No. 1, vp(Jan 1986). Contract AC06-76RL01830.

Composition-based correlations to predict the relative sensitization resistance of AISI 304 and 316 stainless steel (SS) have been evaluated by comparison to a large data base. The best fit to experimental data was achieved using a slightly modified version of Cihal's elemental parameters: Cr] = Cr + 1.6 Mo - 0.2 Ni - 100 C where Cr] is the composite chromium concentration, and all concentrations are expressed as weight percentages (wt%). This composite chromium term effectively normalizes the effects of the major alloying elements on sensitization resistance. Attempts to add other alloying elements such as manganese, silicon, and nitrogen to the equation did not improve the correlation to the data base. Quantitative degree-of-sensitization (DOS) measurements were made on 14 heats of AISI 304 and 316 SS after various isothermal heat treatments using the electrochemical potentiokinetic reactivation (EPR) technique. Comparisons among these heats were found to be consistent with the proposed composite chromium formulism.

34300 **Porous metallic bodies.** Landingham, R. L. (to The United States of America as represented by the United States Department of Energy). US Patent 4,560,621. 24 Dec 1985. Filed date 13 Mar 1984. vp.

PAT-APPL-589255.

Porous metallic bodies having a substantially uniform pore size of less than about 200 microns and a density of less than about 25 percent theoretical, as well as the method for making them. Group IIA, IIIB, IVB, VB and rare earth metal hydrides are heated in a confining container at a controlled rate to a temperature of about greater than the temperature at which the hydride decomposes. Hydrogen is removed from the container and the remaining metal is heated during a second stage to a temperature greater than the temperature at which it was previously heated but not greater than the temperature of 1/2 to 2/3 the temperature at which the metal melts at a controlled rate. The resulting porous metallic body produced has a density less than about 25 percent theoretical and a pore size of less than about 200 microns. The metallic particles of the present invention have high inner surface area and possess minimum resistance to gas flow.

34301 **Generation of ultrafine powders.** Bleier, A. (Metals and Ceramics Div., Oak Ridge National Lab., Oak Ridge, TN 37831). pp 25/6-25/7 of Proceedings of the international symposium workshop on particulate and multiphase processes. Ariman, T.; Veziroglu, T.N. Coral Gables, FL; Clean Energy Research Institute (1985). (CONF-850406—). Contract AC05-84OR21400.

From International symposium and workshop on particulate and multi-phase processes and the 16th annual meeting of the Fine Particle Society; Miami Beach, FL, USA (22 Apr 1985).

The generation of ultrafine powders involves either nucleation and growth or subdivision processes. The first method requires a phase change as new material forms. Specific examples under this classification include condensation from vapor, solidification of liquid droplets, and precipitation from liquid, vapor, and solid solutions. Growth of the new phase requires approach of fresh material in the correct orientation and satisfactory bond energy conditions at the nucleus' surface. These requirements suggest that dislocations in solid nuclei significantly influence particle growth. Examples exist in the literature demonstrating that powder can be produced with average size as large as a few millimeters, depending on the chemical and physical constraints of the system under consideration. Processes based on subdivision emphasize comminution and size-fractionation and constitute a complex technology. Mathematical models that describe changes in particle size distribution during comminution exist but these are often restricted to specific technical schemes. A lower size limit of approximately 1 μm exists for powder that is produced via subdivision of coarse material and that also can be effectively handled; thus the term "ultrafine" may be inappropriate for material generated by these means. This paper emphasizes inorganic powders and focuses on chemical and physical techniques of nucleation and growth since they have an advantage over ones based on subdivision in that ultrafine material with uniform chemical and phase composition, well-defined shape, and a narrow size distribution can be routinely prepared via the former group. General considerations, examples, and limitations of ultrafine powder generation will be discussed. Metal and organic polymer systems will be included where they are appropriate.

34302 Preparation of ultrafine powders by thermal plasma synthesis. Vogt, G.J.; Trkula, M.; Vigil, R.S.; Newkirk, L.R. (Materials Science and Tech. Div., Los Alamos National Lab., Los Alamos, NM 87545). pp 25/4-25/5 of Proceedings of the international symposium workshop on particulate and multi-phase processes. Ariman, T.; Veziroglu, T.N. Coral Gables, FL; Clean Energy Research Institute (1985). (CONF-850406—).

From International symposium and workshop on particulate and multi-phase processes and the 16th annual meeting of the Fine Particle Society; Miami Beach, FL, USA (22 Apr 1985).

Plasma chemical synthesis in a thermal plasma reactor operated at atmospheric pressure is ideally suited for the preparation of ultrafine and refractory powder due to its high temperatures (up to 6000 K) and rapid quench rates (10^3 to 10^7 K/s). At Los Alamos, ultrafine ceramic and metallic powders are being prepared in a thermal RF-plasma reactor utilizing a novel plasma tube developed by the Laboratory. The plasma powders have a fine particle size (<100 nm), are spherical, have a superior phase purity, and have a high absolute purity. Ultrapure, ultrafine powders are prepared by axially injecting reactants into the tail flame or directly into the field zone of an argon plasma. Mixing of the cold reactant with the hot plasma gas has been improved significantly, as compared to radial injecting mixing, by injecting the reactant through a water-cooled stainless steel probe positioned in the plasma on the centerline of the plasma reactor. The electrodeless RF plasma provides a very clean environment for chemical synthesis without electrode erosion (or corrosion by reactive chemicals) and with little contamination from the water-cooled reactor. The RF-plasma reactor can be readily operated for many hours with a stable plasma without a meltdown hazard in the plasma generation zone and without a significant chemical hazard in processing highly reactive and toxic reactants.

34303 Lattice dynamics of α-cerium. Smith, G.S. Ames, IA; Iowa State Univ. (1985). 176p. University Microfilms Order No. 85-16,860.Contract W-7405-ENG-82.

Thesis (Ph. D.).

The lattice dynamics of the fcc α-phase of cerium metal was investigated using inelastic neutron scattering techniques. This phase of cerium is an example of a mixed-valent system. Various physical properties of α-Ce suggest that there may be coupling between the phonons and the f <=> d transitions associated with the mixed valence phenomenon. These measurements of the dispersion curves provide important information about the electron-phonon interaction in this phase of cerium. These studies were not performed in the past because single crystals of α-Ce were not available. We were able to prepare a single α-Ce crystal using a high temperature, high pressure technique. The sample was of sufficient size for inelastic neutron scattering experiments, but the measurements were complicated because of the large mosaic spread (~7.0°) of the crystal. It was possible, however, to obtain a set of dispersion curves along the [00zeta], [zeta,zeta,0], and [zeta,zeta,zeta] symmetry directions. Comparison of the dispersion curves with those of fcc γ-Ce indicate that the branches exhibit anomalous features that may be related to the mixed-valence effects.

34304 Ligand effects for CO and H_2 chemisorption on a polycrystalline Pt_3Ti surface. Bardi, U.; Somorjai, G.A.; Ross, P.N. (Univ. of California, Berkeley). *Journal of Catalysis;* **85**: No. 1, 272-276(Jan 1984). Contract AC03-76SF00098.

The Pt-Ti bimetallic system is interesting for several reasons, but most particularly as an example of an Engel-Brewer type intermetallic. The highly exothermic enthalpy of formation of these alloys has been interpreted in terms of strong bonding interaction of electrons in the d bands of both metals. In principle, such a strong interaction is likely to modify the electronic properties of the metals and cause changes in the chemical properties that are often called ligand effects. Ligand effects have been considered as a possible cause for the increased catalytic activity, as compared to pure Pt, of the Pt_3Ti intermetallic in the electrolytic reduction of oxygen to water in acid fuel cells. Also a ligand effect caused by the Pt-Ti bond is considered to be related to the strong metal-support interaction (SMSI) which is observed when Pt supported to TiO_2 is reduced in hydrogen at elevated temperature. Because of these changes in the catalytic properties of platinum in the presence of Ti, a study was undertaken of the surface properties of the ordered Pt_3Ti intermetallic compound, which has the most exothermic heat of formation in the Pt-Ti system. In this paper the results of a study of carbon monoxide and hydrogen chemisorption, which were used as chemical probes to test the presence of ligand effects, are reported.

34305 (PB—86-156361/XAB) Diffusion in reactor materials. Fedorov, G.B.; Smirnov, E.A. (National Bureau of Standards, Washington, DC (USA)). 1984. Translated from mono. Diffuziya v Reaktornykh Materialakh, Moscow, 1978 by M. K. Bahl. (TT—80-52013). 179p. NTIS, PC A09/MF A01.

The monograph contains a brief description of the principles underlying the theory of diffusion, as well as modern methods of studying diffusion. Data on self-diffusion and diffusion of impurities in a nuclear fuel and fissionable materials (uranium, plutonium, thorium, zirconium, titanium, hafnium, niobium, molybdenum, tungsten, beryllium, etc.) is presented. Anomalous diffusion, diffusion of components, and interdiffusion in binary and ternary alloys were examined. The monograph presents the most recent reference material on diffusion. It is intended for a wide range of researchers working in the field of diffusion in metals and alloys and attempting to discover new materials for application in nuclear engineering. It will also be useful for teachers, research scholars and students of physical metallurgy.

34306 (KY/tr—86/1) Corrosion-resistant materials for fluorine and hydrogen fluoride. Hauffe, K. Translated from *Zeitschrift fuer Werkstofftechnik ;* **15**: 427-435(1984). Contract AC05-84OU21400. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86009957.

Aluminum and Duralumin are resistant against fluorine and hydrogen fluoride up to 600 and 700°K, respectively. The resistance of nickel and its alloys, particularly monel, against fluorine and hydrogen fluoride is fairly good up to 900 and 800°K. During the attack of nickel-chromium alloys by fluorine between 1000 and 1300°K, it appears an inner fluorination similarly to the inner oxidation. The resistance of titanium in water-free liquid fluorine at lower temperatures with <0.3 mm . a^{-1} is comparable to that of nickel and monel. However, the corrosion of titanium in gaseous fluorine amounts at 377 K only 0.0082 mm . a^{-1}. In spite of their limited resistance against fluorine and hydrogen fluoride, very pure molybdenum and tungsten are employed as construction materials in the rocket technology because of their large strength at high temperatures if fluorine-hydrogen and fluorine-hydrazine flames are used. Lanthanum and calcium borides are only little attacked by fluorine hydrazine flames between 1400 and 1800 K; they are superior to all special grade alloys. The same is true in a lower temperature region (290 to 400 K) with fluorcarbon resins. Organic materials substitute in increasing extent metal alloys and non-metal inorganic materials. 87 refs..

34307 Disordering process in an $L1_2$ ordered alloy. Horton, J.A.; DasGupta, A.; Liu, C.T. (Oak Ridge National Lab., TN). *Proceedings - Annual Meeting, Electron Microsopy Society of America;* **42**: 486-487(1984). Contract AC05-84OR21400.

Ordered intermetallic alloys potentially have good high temperature mechanical properties which often are obtained by macroalloying. Since service temperatures may be near the critical ordering temperature, T/sub c/, it is important to understand the disordering processes. The disordering mechanism in an alloy of 52.5 at. % Ni-22.5 Fe-14.5 V-10 Al-0.5 Ti [which can be expressed as $(Ni_{70}Fe_{30})_3(V_{88}Al_{40}Ti_2)$], is presented. The aluminum was added to increase T/sub c/ from 750 to 975°C and stabilize the $L1_2$ structure.

34308 Effect of chemical short range ordering on crystallization of Zr-Ni glasses. Kroeger, D.M.; Koch, C.C.; McKamey, C.G.; Scarbrough, J.O. (Oak Ridge National Lab., TN). *Journal of Non-Crystalline Solids;* **61-62**: 937-942(1984). Contract W-7405-ENG-26.

Previous measurements of low temperature specific heat demonstrated the presence of phase separation and chemical short

range ordering in Zr-Ni glasses with zirconium contents from 60 to 66 at. % Zr. This ordering is found to play a significant role in the crystallization process. 14 references, 4 figures.

34309 **Neutron scattering studies of the high temperature spin dynamics of ferromagnetic materials.** Mook, H.A. (Oak Ridge National Lab., TN). *Journal of Magnetism and Magnetic Materials;* **31-34**: 305-308(1983). Contract W-7405-ENG-26.

The two approaches to understanding the magnetic properties of materials are the localized Heisenberg model and the band theory of electrons. Neutron scattering results at elevated temperatures will be discussed in terms of these models for EuO, Gd and Ni. It is found that measurements near and above the Curie temperature T/sub c/ are particularly useful for distinguishing between models for ferromagnetism in these materials. 10 references, 5 figures.

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REFER ALSO TO CITATION(S) 33550, 33755, 34242, 34243, 34260, 34302, 34589, 35346

34310 **(AD-A—163762/8/XAB) Moessbauer investigation of intermetallic hydrides. Final report, 1 November 1982-31 October 1985.** Oliver, F.W. (Morgan State Univ., Baltimore, MD (USA)). 21 Dec 1985. 6p. NTIS, PC A02/MF A01.

This research was a study of hydrogen absorption in intermetallic hydrides. Mossbauer and x-ray-diffraction measurements were used to aid in a determination of the hydrogen-absorbing mechanism occurring in hydriding. Information was sought that would provide insight into the nature of bonding and interaction between the absorbed hydrogen and the various sites in the intermetallics. There was also interest in observing what happened to Sn in intermetallic compounds when hydrided. Studies were made of the changes in isomer shift and linewidth upon hydriding.

34311 **(AD-A—163859/2/XAB) Relationship of fatigue and fracture to microstructure and processing in Al_2O_3 fiber reinforced metal matrix composites.** Page, R.A.; Leverant, G.R. (Southwest Research Inst., San Antonio, TX (USA). Dept. of Materials Sciences). 1985. 23p. NTIS, PC A02/MF A01.

The tensile and fatigue properties of three matrices, including commercially pure magnesium, ZE41A (Mg-4.25Zn-0.5Zr-1.25RE), and Al_3Li, containing 35 vol pct FP Al_2O_3 fibers were studied as a function of orientation between the loading and fiber axes, matrix composition, fiber volume fraction, and fiber/matrix interfacial chemistry. It was found that the axial properties were controlled by the fiber strength, and the orientation dependence of tensile strength could be analyzed in terms of the critical strains to fracture parallel and normal to the fibers. Matrix chemistry modifications had little influence on fiber strength but significantly increased the matrix and interface strengths. A transition from fiber-controlled fracture to matrix/interface controlled fracture was found as the 90 deg. As the matrix and interface strengths increased, a transition in fatigue properties were primarily controlled by the matrix and/or interface strengths. Little benefit was achieved by increasing the vol pct fibers from 35 to 55, unless the fibers were involved in the fracture process. The interfacial reaction zone was identified as MgO int he Mg-base composites and $LiAl_5O_8$ in the Al_3Li composite.

34312 **(AD-A—164253/7/XAB) Thermodynamics of high-temperature materials. Annual report, 1 October 1984-30 September 1985.** (National Bureau of Standards, Washington, DC (USA)). 24 Dec 1985. 125p. NTIS, PC A06/MF A01.

Contents include: research on thermophysical properties; high-temperature enthalpy measurements; broad-band spectroscopy of small molecules in intense laser fields; growth and decomposition of graphitic structure; buildup and irradiation of obscuring clouds under near vacuum conditions - application to spacecraft survivability; and molecular basis for laser-induced vaporization of refractory materials.

34313 **(CONF-860421—47) Studies of surface adsorption on $LiAlO_2$.** Fischer, A.K.; McDaniel, J.A.; Johnson, C.E. (Argonne National Lab., IL (USA); Maine Univ., Farmington (USA). Dept. of Chemistry). 1986. Contract W-31-109-ENG-38. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010496.

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

Computational and experimental approaches are being taken to understanding surface adsorption/desorption effects on tritium inventory and release. The computational survey integrates a thermodynamic treatment of surface adsorption and bulk phase effects such as solubility and gas phase composition. The system T_2O:T_2:$LiAlO_2$ was examined. The calculations indicate that surface adsorption can be expected to contribute most to tritium inventory under the conditions of lower temperatures and higher oxygen activities. Higher temperature and lower oxygen activity favor lower surface inventory. In the experimental work, a high temperature gas chromatograph was constructed in order to measure the H_2O:H_2 surface adsorption isotherms and the solubility of hydroxide in $LiAlO_2$. Preliminary data indicate that at 478K approximately 15% of the surface is covered for a partial pressure of H_2O of approximately 52 Pa. Calculated values can be obtained that are in reasonable agreement with this.

34314 **(CONF-860743—1) Initial results of a high-power microwave sintering experiment at ORNL.** Kimrey, H.D.; White, T.L.; Bigelow, T.S.; Becher, P.F. (Oak Ridge National Lab., TN (USA)). 1986. Contract AC05-84OR21400. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010041.

From 21. microwave power symposium; Memphis, TN, USA (28 Jul 1986).

Experiments have recently begun at Oak Ridge National Laboratory to develop microwave sintering techniques suitable for large ceramic parts. Microwave sintering offers the advantages of faster heating rates, more uniform heating, and greater energy efficiency than conventional sintering techniques. We are using 28-GHz, 200-kW cw gyrotrons as the heating source. An untuned cavity is used as the applicator to eliminate geometry sensitivity in coupling efficiency.

34315 **(CONF-8606101—1) N-ion irradiation studies of VN thin films.** Ellis, J.T.; Christen, D.K.; Lewis, J.D.; Sekula, S.T.; Thompson, J.R.; Williams, J.M. (Oak Ridge National Lab., TN (USA)). May 1986. Contract AC05-84OR21400. 18p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86011065.

From 5. international conference on ion beam modification of materials; Catania, Italy (9 Jun 1986).

Thin films of VN have been formed by reacting films of vanadium metal, prepared by e-beam evaporation, with N_2 gas. The superconducting transition temperature T/sub c/, electrical resistivity, x-ray diffraction spectra and temperature dependent upper critical field H/sub c2/ of these films were studied as a function of nitrogen ion irradiation. T/sub c/ is found to decrease exponentially with incident ion fluence to a total change of 42%, while the residual resistivity increases exponentially, both saturating at about the same fluence. This exponential behavior is derived from a simple defect production and annealing model. H/sub c2/ is found to fit WHH theory at all ion doses, with a maximum H/sub c2/(0) at 4 x 10^{14} N-ions/cm^2. γ^*, calculated form the slope of H/sub c2/ at T/sub c/, is observed to be correlated with T/sub c/; therefore, γ^* also decreases with fluence.

34316 **(DOE/NASA—4148-1) Joining of ceramics for advanced heavy-duty diesels.** Moorhead, A.J.; Keating, H. (Oak Ridge National Lab., TN (USA)). Mar 1986. Contract AC05-84OR21400. 63p. (ORNL—6262; NASA/CR—175019). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86011361.

The wettability and adherence in vacuum of a series of metal alloys on several oxide ceramics were investigated with the goal of identifying those compositions suitable as filler metals for direct brazing of ceramics in uncooled diesel engine applications. Wetting behavior was determined by the sessile-drop technique. Adherence

was measured by several tests including sessile-drop shear, flexure strength of ceramics brazed in a butt-joint configuration, fracture toughness using a composite double cantilever beam specimen, and, in the case of ceramic-metal brazements, by a bar/pad shear test. Compositions were identified in both the Cu-Ag-Ti and Cu-Au-Ti ternary systems that wet and strongly adhered to high-purity aluminas, partially stabilized zirconia ceramics, and alumina reinforced with SiC whiskers. Excellent flexural strengths, at temperatures up to 600°C, of brazements containing these filler metals indicate that these materials are good candidates for use in advanced heavy-duty diesel engines. They have the advantage over competing systems of not requiring that the ceramic be metallized before brazing.

34317 (Juel-Conf—54, pp 174-183) **Characterization of TRUW ceramics in relation to geological disposal in clay.** Iseghem, P. van; Hennart, D.; Batist, R. de. (Centre d'Etude de l'Energie Nucleaire, Mol, Belgium. Materials Physics Dept.; Centre d'Etude de l'Energie Nucleaire, Mol, Belgium. Waste Dept.; Rijksuniversitair Centrum te Antwerpen, Belgium). Jun 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE86752037. (CONF-8506114—).

From International seminar on radioactive waste products suitability for final disposal; Julich, F.R. Germany (10 Jun 1985).

Various waste forms are being studied in Belgium for their suitability for geological disposal, such as high-level waste glasses, alpha waste ceramics, medium-level waste bitumen, and hulls incorporated in lead or concrete. In this paper, attention will be focussed on ceramics, resulting from the high temperature slagging incineration of both combustible and non-combustible alpha waste. Test runs were carried out with either simulated or Pu doped alpha waste, and with simulated or real $\beta\gamma$ active waste.

34318 (MLM—3357-OP) **Comparison of structures and electronic properties between TiCoH/sub x/ and TiFeH/sub x/.** Cantrell, J.S.; Bowman, R.C. Jr. (Miami Univ., Oxford, OH (USA). Dept. of Chemistry; Aerospace Corp., Los Angeles, CA (USA). Chemistry and Physics Lab.). 1986. Contract AC04-76DP00053. 20p. (CONF-8605114—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011336.

From Properties and applications of metal hydrides; Maubuisson, France (25 May 1986).

A comparison is made between apparently isostructural TiCoH/sub x/ and TiFeH/sub x/ materials. The x-ray diffraction data for these two ternary hydrides are very similar for the compositions $x \simeq 1.0$ (β_1-phase) and $x \simeq 1.5$ (β_2-phase). However, monoclinic (γ-phase) for TiFeH/sub x/ with $x \simeq 2$ was not found for TiCoH/sub x/ whose maximum composition is $x \simeq 1.5$. The proton spin-lattice relaxation times (T_1) are compared for both TiCoH/sub x/ and TiFeH/sub x/. The (T_1T)/sup -1/2/ values for TiFeH/sub x/ samples are much greater than for the TiCoH/sub x/samples. This is thought to be due to the larger proton hyperfine field that arises from polarization of the Fermi level Fe 3d states in addition to the Fermi level Ti 3d states. The smaller magnetic susceptibilities for TiCoH/sub x/ β-phase samples also strongly suggest reduced Fermi level densities of states in the TiCoH/sub x/ samples.

34319 (PB—86-168762/XAB) **Ceramic tube materials and processing development. Topical report, February 1982-December 1984.** Green, K.E.; Rivkin, M.I.; Roy, D.W. (Coors Porcelain Co., Golden, CO (USA)). Jul 1985. 51p. NTIS, PC A04/MF A01.

A cost-effective material/process has been developed for fabrication of SiC tubes that satisfy many of the structural and operating environment requirements for high-temperature heat recovery systems. Available property data plus cost projects are presented. Accomplishments and results include: Extensive search for and final selection of lowest-cost starting materials commercially available at the time; Development of appropriate body formulations and processes to successfully utilize the respective low-cost raw materials selection; Development of an extrusion process (including tool design) to successfully fabricate and dry tubing; Development of an optimal firing (siliconizing) cycle to adequately infiltrate the extruded tubes so they would yield measured properties which would meet or exceed the agreed upon specifications set down in concert with systems designers; A final standardized process that should yield acceptable reaction bonded SiC tubing well within the target pricing in large quantities.

34320 **High-temperature precipitation hardening of two-phase Y_2O_3-partially-stabilized ZrO_2 single crystals: A first report.** Dominguez-Rodriguez, A.; Lanteri, V.; Heuer, A.H. (Dept. of Metallurgy and Materials Science, Case Western Reserve Univ., Cleveland, OH 44106). *Journal of the American Ceramic Society;* **69**: No. 3, vp(Mar 1986). Contract FG02-84ER45110.

High-temperature plastic deformation of Y_2O_3-stabilized ZrO_2 single crystals is of importance in the general field of oxide plasticity, and to complement the current interest in the strong and tough polycrystalline ceramics that can be produced in this system. Ingel and co-workers have studied the mechanical properties of single crystals in this system and observed unusually high high-temperature strengths in two-phase alloys. Lankford studied the plastic deformation of Y_2O_3-partially-stabilized and Y_2O_3-fully-stabilized ZrO_2 in compression between room temperature and 1150°C and found that the strengths decreased rapidly with increasing temperature. No tetragonal → monoclinic transformations occurred during the deformation of the partially stabilized single crystal. In the present paper, the authors report on the deformation of a crystal containing 4.5 mol% Y_2O_3 and being two-phase (high solute cubic (c) ZrO_2 and low solute tetragonal (t) ZrO_2 at the deformation temperature (1400°C). Precipitation hardening was observed in two-phase (cubic plus tetragonal) Y_2O_3-partially-stabilized ZrO_2 single crystals deformed at 1400°C. Slip was activated on [001](110), primarily in Luders bands.

34321 **Phase equilibration in ZrO_2-Y_2O_3 alloys by liquid-film migration.** Chaim, R.; Heuer, A.H.; Brandon, D.G. (Dept. of Metallurgy and Materials Science, Case Western Reserve Univ., Cleveland, OH 44106). *Journal of the American Ceramic Society;* **69**: No. 3, vp(Mar 1986). Contract FG02-84ER45110.

The tetragonal (t) and cubic (c) ZrO_2 solid solutions in two-phase ZrO_2-8 wt% Y_2O_3 ceramics have low and high solute content, respectively. Annealing samples sintered at 1600°C between 700° and 1400°C requires a change in the volume fraction of the coexisting phases, as well as their equilibrium Y_2O_3 content. The enrichment in Y_2O_3 content of the c-ZrO_2 grains is accomplished by liquid-film migration involving the ubiquitous silicate grain-boundary phase, while the volume fraction of t-ZrO_2 increases by the nucleation and growth of cap-shaped t-ZrO_2 lenses. The interfaces between the c-ZrO_2 matrix and the growing t-ZrO_2 lenses are semicoherent.

34322 **Exaggerated grain growth in ZrO_2-toughened Al_2O_3.** Kibbel, B.; Heuer, A.H. (Dept. of Metallurgy and Materials Science, Case Western Reserve Univ., Cleveland, OH 44106). *Journal of the American Ceramic Society;* **69**: No. 3, vp(Mar 1986). Contract AC02-83ER45006.

Annealing of ZrO_2-toughened Al_2O_3 (ZTA) at elevated temperatures causes growth of both the intergranular ZrO_2 particles and the Al_2O_3 "matrix" grains. Exaggerated ("breakaway") grain growth occurs in some, but not all, specimens. Analytical electron microscopy of two ZTA's, both of which contained a continuous amorphous (glassy) grain-boundary phase, but only one of which showed breakaway grain growth, revealed that the occurrence of breakaway grain growth could be correlated with the chemistry of the ubiquitous glassy grain-boundary phase.

34323 **Plastic deformation and solid-solution hardening of Y_2O_3-stabilized ZrO_2.** Dominguez-Rodriguez, A.; Lagerlof, K.P.D.; Heuer, A.H. (Case Western Reserve Univ., Dept. of Metallurgy and Materials Science, Cleveland, OH 44106). *Journal of the American Ceramic Society;* **69**: No. 3, vp(Mar 1986). Contract FG02-84ER45110.

Fully stabilized cubic ZrO_2 single crystals containing various Y_2O_3 concentrations were deformed at 1400°C in air. The orientation chosen favored [001](110) slip, which was confirmed by slip-trace analysis and transmission electron microscopy; [110](110) slip could also be activated. The yield and flow stresses increased with increasing Y_2O_3 concentration, and stress-strain curves were domi-

nated by a region of zero work hardening from very small strains for all compositions.

34324 **Degradation during aging of transformation-toughened ZrO_2-Y_2O_3 materials at 250°C.** Lange, F.F.; Dunlop, G.L.; Davis, B.I. (Structural Ceramics, Rockwell International Science Center, Thousand Oaks, CA 91360). *Journal of the American Ceramic Society;* **69**: No. 3, vp(Mar 1986). Contract FG03-84ER45124.

The detrimental aging phenomenon observed in ZrO_2-Y_2O_3 materials, which causes tetragonal ZrO_2 to transform to its monoclinic structure at temperatures between 150 and 400°C, was investigated with respect to the gaseous aging environment and the Y_2O_3 and SiO_2 content of the material. It is shown that the aging phenomenon is caused by water vapor and that intergranular silicate glassy phases play no significant role. Transmission electron microscopy of thin foils, before and after aging, showed that the water vapor reacted with yttrium in the ZrO_2 to produce clusters of small (20 to 50 nm) crystallites of α-$Y(OH)_3$. It is hypothesized that this reaction produces a monoclinic nucleus (depleted of Y_2O_3) on the surface of an exposed tetragonal grain. Monoclinic nuclei greater than a critical size grow spontaneously to transform the tetragonal grain. If the transformed grain is greater than a critical size, it produces a phenomenon and results in catastrophic degradation. Degradation can be avoided if the grain size is less than the critical size required for microcracking.

34325 **Fracture toughness of MgO-partially-stabilized ZrO_2 specimens with K/sub R/-curve behavior from transformation toughening.** Burns, S.J.; Swain, M.V. (Materials Science Program, Dept. of Mechanical Engineering, Univ. of Rochester, Rochester, NY 14627). *Journal of the American Ceramic Society;* **69**: No. 3, vp(Mar 1986).

Transformation-toughened MgO-partially-stabilized ZrO_2 exhibits a crack-wake-induced load-point displacement in fracture samples. The equations of linear elastic fracture mechanics were self-consistently reformulated to include the residual displacement from the transformation wake. Application of these equations to double-cantilever-beam specimens of transformation-toughened ZrO_2, with the martensitic start transformation temperature close to the testing temperature, gives a decreasing K/sub R/ curve and initial toughness values near 30 MPa.m/sup 1/2/.

34326 **Transformation and microcrack toughening as complementary processes in ZrO_2-toughened Al_2O_3.** Ruhle, M.; Claussen, N.; Heuer, A.H. (Max-Planck Institut fur Metallforschung, Stuttgart). *Journal of the American Ceramic Society;* **69**: No. 3, vp(Mar 1986). Contract FG02-84ER45110.

Both tetragonal (t) and monoclinic (m) ZrO_2 particles in ZrO_2-toughened Al_2O_3 can give rise to toughening. In the stress field of propagating cracks, the t-ZrO_2 particles can undergo the stress-induced t $\rightarrow$ m transformation, and the residual stresses around already-transformed m-ZrO_2 particles can cause microcracking. The t-ZrO_2 particles transformed in crack tip stress fields do not, however, also cause appreciable microcracking. The toughening increments via these distinct mechanisms are comparable. It appears that optimally fabricated ZrO_2-toughened Al_2O_3's should contain a mixture of t- and m-ZrO_2.

34327 **Implications of transformation plasticity in ZrO_2-containing ceramics: II, Elastic-plastic indentation.** Chen, I.-W. (Dept. of Nuclear Engineering and Dept. of Materials Science and Engineering, Massachusetts Inst. of Technology, Cambridge, MA 02139). *Journal of the American Ceramic Society;* **69**: No. 3, vp(Mar 1986).

Indentation hardness of partially stabilized zirconia was found to be 8.2 times the uniaxial compressive yield stress. This ratio is anomalously high for ceramic materials and is attributed to pressure hardening in transformation plasticity. An analytic solution of elastic-plastic indentation using the spherical-hole model is given, based on a pressure-sensitive idealized yield criterion. The theory correctly predicts a higher hardness and a plastic zone, both in quantitative agreement with the experimental observations in Mg-PSZ. Data analysis further reveals a large disparity of yield stress and hardness values among cubic, tetragonal, and monoclinic zirconias, resulting from their different phase transformation and twinning capabilities. The broader implications of pressure sensitivity in elastic-plastic identation are rationalized.

34328 **Ceramics: 1. Shear and dilatation effects.** Chen, I.-W.; Morel, P.E.R. (Dept. of Nuclear Engineering and Dept. of Materials Science and Engineering, Massachusetts Inst. of Technology, Cambridge, MA 02139). *Journal of the American Ceramic Society;* **69**: No. 3, vp(Mar 1986). Contract FG02-84ER45154.

Transformation plasticity in ZrO_2-containing ceramics generally exhibits shear and dilation effects of comparable magnitude. The coupling between external stresses and crystallographic strains assists the tetragonal-monoclinic transformation, which, via shear localization, gives rise to macroscopic shear and dilatant deformation. Application of a yield criterion based on both shear and dilatation effects correctly correlates deformation data from tension, compression, bending, and indentation, and further delineates a crack-tip process zone comparable to the one observed experimentally. Similar shear and dilatation effects in microcracking due to transformation plasticity are explored. These findings suggest that the strength of the ultimate transformation-toughened structural ceramics should be yield limited and sensitive to the stress state. Strategies for fracture control are recommended.

34329 **Ultrasonic shear wave couplant.** Kupperman, D. S.; Lanham, R. N. (to US DOE). US Patent 4,559,827. 24 Dec 1985. Filed date 11 Apr 1984. vp.

PAT-APPL-599108.

Ultrasonically testing of an article at high temperatures is accomplished by the use of a compact layer of a dry ceramic powder as a couplant in a method which involves providing an ultrasonic transducer as a probe capable of transmitting shear waves, coupling the probe to the article through a thin compact layer of a dry ceramic powder, propagating a shear wave from the probe through the ceramic powder and into the article to develop echo signals, and analyzing the echo signals to determine at least one physical characteristic of the article.

34330 **Microwave coupler and method.** Holcombe, C. E. (to USA as represented by the US Dept. of Energy). US Patent 4,559,429. 17 Dec 1985. Filed date 29 Nov 1984. vp.

PAT-APPL-6[illegible]42.

The present inv[illegible]tion is directed to a microwave coupler for enhancing the heating or metallurgical treatment of materials within a cold-wall, rapidly heated cavity as provided by a microwave furnace. The coupling material of the present invention is an alpha-rhombohedral-boron-derivative-structure material such as boron carbide or boron silicide which can be appropriately positioned as a susceptor within the furnace to heat other material or be in powder particulate form so that composites and structures of boron carbide such as cutting tools, grinding wheels and the like can be rapidly and efficiently formed within microwave furnaces.

34331 **Abrasive slurry composition for machining boron carbide.** Duran, E. L. (to The United States of America as represented by the United States Department of Energy). US Patent 4,544,376. 1 Oct 1985. Filed date 29 Nov 1984. vp.

PAT-APPL-676045.

An abrasive slurry particularly suited for use in drilling or machining boron carbide consists essentially of a suspension of boron carbide and/or silicon carbide grit in a carrier solution consisting essentially of a dilute solution of alkylaryl polyether alcohol in octyl alcohol. The alkylaryl polyether alcohol functions as a wetting agent which improves the capacity of the octyl alcohol for carrying the grit in suspension, yet without substantially increasing the viscosity of the carrier solution.

34332 **Structural ceramic research and development in Japan.** Johnson, D.R.; Schulz, R.B. (Oak Ridge National Lab., TN). *American Ceramic Society Bulletin;* **64**: No. 3, 376-379(Mar 1985). Contract AC05-84OR21400.

Intense activity in technical ceramic development in Japan in recent years has sparked a significant interest in the Japanese ce-

ramic research effort. This study is directed specifically to structural ceramics, and in particular, to those with applications in advanced heat engines. Nonetheless, the descriptions of government organizations and programs are relatively generic to the development of fine ceramics in Japan.

34333 **The effect of particle size distribution on the coagulation of ceramic suspensions.** Strauss, M.T.; Ring, T.A.; Bowen, H.K.; Bleier, A. (Dept. of Materials Science and Engineering, Massachusetts Inst. of Tech., Cambridge, MA 02139). pp 14/1-14/2 of Proceedings of the international symposium workshop on particulate and multi-phase processes. Ariman, T.; Veziroglu, T.N. Coral Gables, FL; Clean Energy Research Institute (1985). (CONF-850406—).

From International symposium and workshop on particulate and multi-phase processes and the 16th annual meeting of the Fine Particle Society; Miami Beach, FL, USA (22 Apr 1985).

Processing ceramics often involves the dispersion of powders as slips and slurries. The use of aqueous and nonaqueous solvents combined with electrostatic or steric stabilization of the particles against coagulaton is convenient for several shaping and forming technologies -- e.g., slip casting, tape casting, and electrophoretic deposition -- and is used to produce uniform green bodies. Agglomerates that are formed during processing can degrade the properties and performance of sintered ceramics. This work focuses on the effects of polydispersity on the coagulation of oxide powders suspended in water. The purpose is to determine the powder characteristics that minimize the formation of agglomerates as inhomogeneous centers within the green microstructure. Since homogeneous, unagglomerated slips of slurries are desired for processing, what are the effects of the particle size and size distribution, volume fraction solids, electrolyte and surface characteristics on the stability of the dispersion relative to coagulation?

34334 **Charge regulation and its impact on the stability of concentrated colloidal suspensions containing oxide particulates.** Bleier, A. (Oak Ridge National Lab., Oak Ridge, TN 37831). pp 3/1-3/2 of Proceedings of the international symposium workshop on particulate and multi-phase processes. Ariman, T.; Veziroglu, T.N. Coral Gables, FL; Clean Energy Research Institute (1985). (CONF-850406—). Contract AC05-84OR21400.

From International symposium and workshop on particulate and multi-phase processes and the 16th annual meeting of the Fine Particle Society; Miami Beach, FL, USA (22 Apr 1985).

The understanding of concentrated colloidal suspensions that contain oxide particulates is becoming increasingly important for various consolidation techniques used to fabricate high performance ceramic components. Some current research designed to address this area has emphasized the use of monosized metal oxide powders, owing to their relatively uniform properties, as compared to those of conventionally produced powders. The present state of understanding of concentrated suspensions constitutes an area of active research for the colloid science community and needs to be developed further. Current limitations stem from the fact that traditional models requiring either constant surface potential or constant surface charge to evaluate overlap of electrical double layers are inadequate for concentrated, aqeous oxide suspensions and do not reasonably estimate particulate behavior. This paper addresses that part of the problem area relating to surface chemical thermodynamics and acid-base behavior by emphasizing the electrochemical equilibrium established between a particle surface and its environment.

34335 **Ultrasonic wave propagation characteristics of green ceramics.** Kupperman, D.S.; Karplus, H.B. (Argonne National Lab., IL). *American Ceramic Society Bulletin;* 63: No. 12, 1505-1509(Dec 1984). Contract W-31-109-ENG-38.

Propagation of ultrasonic waves in green (unfired) ceramics is studied, and the effectiveness of ultrasonic methods for nondestructive evaluation is assessed. The objective is to obtain useful information on defects, cracking, delaminations, agglomerates, inclusions, regions of high porosity, and anisotropy. Conventional ultrasonic techniques are difficult to apply to flaw detection in green ceramics because of the high attenuation, fragility, and couplant-absorbing properties of these materials. However, velocity, attenuation, and spectral data were obtained with pressure-coupled transducers and provided useful information related to density variations and the presence of agglomerates and elastic anisotropy.

34336 **Thermodynamic modeling of UO/sub 2+/-x/.** Lindemer, T.B.; Besmann, T.M. (Oak Ridge National Lab., TN). pp 117 of IUPAC conference on chemical thermodynamics. Hamilton, Ontario; McMaster University (1984). (CONF-840807—).

From Conference on chemical thermodynamics and 39. calorimetry conference; Hamilton, Canada (13 Aug 1984).

The entire oxygen potential (μ/sub O_2/) data base for UO/sub 2+x/ with the calcium fluorite structure was retrieved from the literature and used in modeling μ/sub O_2/ as a function of T and x. A total of 1657 values were compiled from 35 publications, spanning 25 years and ranging over the limits $1.69 \leqq O/U \leqq 2.27$, $735\ K \leqq T \leqq 2873\ K$, and $-785\ kJ\ x\ mol^{-1} \leqq \mu/sub\ O_2/ \leqq O\ kJ\ x\ mol^{-1}$. Regular solid solution models were generally used to fit the results. Two criteria were applied in selecting the proper solution model: the model had to reproduce the observed slope of the ln rho/sub O_2/ against ln x plots, and the plot of μ/sub O_2/ (obs) - μ/sub O_2/ (calc) against T had to be well-behaved. Collectively, this analysis revealed that values for UO/sub 2+x/ at $x > 0.07$ were critical in selecting the proper oxide of uranium to be used in solution with UO_2.

34337 **Thermodynamic measurements and modeling of PuO/sub 2-x/ and U/sub 1-z/Pu/sub z/O/sub 2+x/.** Besmann, T.M.; Lindemer, T.B. (Oak Ridge National Lab., TN). pp 118 of IUPAC conference on chemical thermodynamics. Hamilton, Ontario; McMaster University (1984). (CONF-840807—).

From Conference on chemical thermodynamics and 39. calorimetry conference; Hamilton, Canada (13 Aug 1984).

All oxygen potential-composition-temperature values for the calcium fluorite-structured PuO/sub 2-x/ and U/sub 1-z/Pu/sub z/O/sub 2+x/ have been extracted from the literature for use in developing predictive chemical thermodynamic models of the phases. The models are based upon simple regular solutions of plutonium and uranium oxides whose combination yields oxygen potential-composition-temperature relationships that conform to the consensus data base. In particular, the models accurately reflect the ln p/sub O_2/ against ln x relationships exhibited by the values. Such agreement is lacking in all previously derived models. The regular solution interaction energies were typically found to be low, in accord with the general view of regular solutions. Small adjustments to the standard Gibbs free energy changes in the oxygen-bearing reactions were necessary, however, in order to obtain optimal fitting of the data.

34338 **Theory of high-temperature phase transitions in actinide oxides.** Tam, S.W.; Fink, J.K.; Leibowitz, L. (Argonne National Lab., IL). pp 126 of IUPAC conference on chemical thermodynamics. Hamilton, Ontario; McMaster University (1984). (CONF-840807—).

From Conference on chemical thermodynamics and 39. calorimetry conference; Hamilton, Canada (13 Aug 1984).

The possible occurrence of a diffuse phase transition in actinide oxides has been discussed in the literature for some time. Such phase transitions are well known in other fluorite and anti-fluorite compounds. Recent reanalysis of existing enthalpy, creep, and fission-gas release data has suggested possible connections between the anomalies observed in these experiments and the proposed phase transition. The precise nature of the connection is presently unclear. In other fluorites, such phase transitions involve massive disordering (Frenkel defect concentrations up to several per cent) in the anion sub-lattice. Diffusion-limited phenomena, however, such as high-temperature creep and fission-gas release, also involve defects on the cation sub-lattice. Here a theory of high-temperature phase transitions is proposed for the actinide oxides which includes explicitly both Frenkel and Schottky defects. Defect interaction is included within the extended Debye-Hueckel approximation in consideration of both defect enthalpy of formation and configurational entropy. Implications of this theory for thermophysical and mechanical properties as well as fission product behavior and neutron scattering are discussed.

34339 **Preparation of strontium titanate ceramics and internal boundary layer capacitors by the Pechini method.** Budd, K.D.; Payne, D.A. (Univ. of Illinois, Urbana). *Materials Research Society Symposia Proceedings;* 32: 239-244(1984). Contract AC02-76ER01198.

High purity, fine-grain size, $SrTiO_3$ ceramics were fabricated from powders which were chemically derived by the Pechini method. The preparation is based upon a thermally polymerizable water-ethylene glycol-citric acid system in which a wide range of metal alkoxides, carbonates, and metal salts are soluble. The process is a closed system, and lends itself to the preparation of complex oxides which can contain numerous additives and dopants. In this study, W-doped $SrTiO_3$ powders were prepared with various Sr:Ti ratios, and fine grain internal boundary layer capacitors were fabricated by controlled segregation in sintering. Characteristics of the resin, powder, microstructures, and electrical properties are reported. The advantages and disadvantages of this method of chemical preparation for ceramic materials are noted. 4 references, 4 figures, 1 table.

34340 **Crystallography of annealing twins in alumina ceramics.** Shiue, Y.R.; Phillips, D.S. (Univ. of Illinois, Urbana). *Philosophical Magazine,* [*Part*] *A: Defects and Mechanical Properties;* 50: No. 5, 677-702(1984). Contract AC02-76ER01198.

The crystallography of basal and rhombohedral annealing twins in polycrystalline alumina ceramics has been analyzed by selected area electron diffraction, and secondary grain boundary dislocations (SGBDs) within those boundaries have been analyzed. The twins arise from misorientations of the high coincidence fraction Σ, and the SGBDs have Burgers vectors from the displacement shift complete lattice (DSCL). The basal twin is unique to the rhombohedral system. A 0 lattice calculation is used to show that the rhombohedral twin is similar to the $\Sigma = 7$ <210> boundary in hexagonal metals. 25 references, 15 figures.

34341 **$Si_3Al_4N_4C_3$ and $Si_2Al_3N_3C_3$ compounds as SiC-AlN solid solutions.** Zangvil, A.; Ruh, R. (Univ. of Illinois, Urbana). *Journal of Materials Science Letters;* 3: 249-250(1984).

In a recent note Tsukuma et al. reported the existence of the compounds $Si_3Al_4N_4C_3$ and $Si_2Al_3N_3C_3$ with the wurtzite (2H) structure. While the former was synthesized from Si_3N_4 and Al_4C_3 and the latter from Si_3N_4, Al_4C_3 and AlN, it is suggested that both these compounds lie on the SiC-AlN join in the quasi-quaternary system SiC-Si_3N_4-AlN-Al_4C_3). The SiC-AlN system has been extensively investigated. This work has shown that SiC and AlN form a continuous 2H solid solution over much of the composition range by hot pressing in vacuum at 2100°C. At $\leqq$ 1900°C dense two-phase SiC-AlN particulate composites were formed. Two-phase mixtures of SiC and AlN, rather than solid solutions, were also obtained when equal molar ratios of SiC and AlN or Si_3N_4 and Al_4C_3 were hot pressed at 1860°C.

3603 Composite Materials

34342 **(AD-A—164136/4/XAB) Mixture model for unidirectionally fiber-reinforced composites. Technical report, July 1984-December 1985.** Murakami, H.; Hegemier, G.A. (California Univ., San Diego, La Jolla (USA). Dept. of Applied Mechanics and Engineering Sciences). Dec 1985. 37p. NTIS, PC A03/MF A01.

A binary-mixture theory with microstructure is constructed for unidirectionally fiber-reinforced elastic composites. Model construction is based on a asymptotic scheme with multiple scales and the application of Reissner's new mixed variational principle (1984). In order to assess the accuracy of the model, comparison of the mixture model predictions with available experimental data on dispersion of harmonic waves is made for boron/epoxy and tungusten/aluminum composites. Formulas for the effective moduli are also presented, and the results are compared with the test data and other available predictions.

34343 **Process for the preparation of fiber-reinforced ceramic composites by chemical vapor deposition.** Lackey, W.J. Jr.; Caputo, A.J. (to Dept. of Energy, Washington, DC). US Patent 4,580,524. 8 Apr 1986. Filed date 7 Sep 1984. vp.

Apparatus is described for performing vapor deposition on a fibrous or porous substrate, comprising: (a) a housing having a chamber with an opening at one end thereof; (b) means for mounting a porous or fibrous substrate having opposite surfaces and outer edges in the opening in the housing chamber with the outer edges spaced from the housing for defining therewith a gas receiving void in registry with the housing chamber; (c) heating means in association with the housing chamber for heating the surface of the fibrous substrate facing into the housing chamber; (d) cooling means for cooling the surface of the fibrous substrate facing away from the housing chamber; (e) means for providing a flow of reactant gas to the cooled surface of the fibrous substrate; (f) seal means disposed between the housing and the cooled surface of the substrate for conducting the reactant gas into the substrate; and (g) means exhausting from the housing chamber the gases exiting the heated surface of the fibrous substrate during initial phases of the vapor deposition and then from the edges of the substrate through the gas receiving void from the housing chamber, the heating means and the cooling means, when in use, creating a temperature gradient across the fibrous substrate.

3604 Polymers And Plastics

REFER ALSO TO CITATION(S) 34301

34344 **(SAND—86-0626) Diffusion of HCPB through Sylgard 184.** Renschler, C.L.; Gillen, K.T.; Keenan, M.R. (Sandia National Labs., Albuquerque, NM (USA)). May 1986. Contract AC04-76DP00789. 19p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86011544.

The technique of density profiling was used to monitor the diffusion of the hydrogen getter bis-hydroxycyclopentylbutadiyne (HCPB) through the Sylgard 184 silicon rubber used as an encapsulant. It was found that some of the getter would react with excess hydrosilance groups unreacted during the silicone cure. This immobilized those getter molecules and led to the formation of a concentration front, or plateau, in the diffusion profiles. Kinetic modeling provided a method of determining the average getter diffusion coefficient. Using the experimentally determined activation energy of 13 kcal/mol and assuming a worst-case effective kinetic temperature of 47°C, the predicted time necessary for half the getter to diffuse into the encapsulant is ca. 54 years.

34345 **Electrically conductive doped block copolymer of polyacetylene and polyisoprene.** Aldissi, M. (to Dept. of Energy, Washington, DC). US Patent 4,554,093. 19 Nov 1985. Filed date 27 Jun 1984. vp.
PAT-APPL-625323.

An electrically conductive block copolymer of polyisoprene and polyacetylene and a method of making the same are disclosed. The polymer is prepared by first polymerizing isoprene with n-butyllithium in a toluene solution to form an active isoprenyllithium polymer. The active polymer is reacted with an equimolar amount of titanium butoxide and subsequently exposed to gaseous acetylene. A block copolymer of polyisoprene and polyacetylene is formed. The copolymer is soluble in common solvents and may be doped with I_2 to give it an electrical conductivity in the metallic regime.

34346 **Simple kinetic approach to fiber failure.** Cook, R. (Lawrence Livermore National Lab., CA). *Polymer Communications;* 25: 246-249(Aug 1984). Contract W-7405-ENG-48.

A simple kinetic approach to fiber failure which includes the possibility of environmental degradation as well as an approximate treatment of load sharing is developed. It is shown that, within the context of the model, fiber lifetimes as a function of load level are only weakly affected by the load sharing parameter. However, environmental effects have a dramatic effect on fiber lifetimes at low

load levels and furthermore these effects cannot be predicted by data taken at high load levels. 9 references, 3 figures, 2 tables.

3606 Other Materials

REFER ALSO TO CITATION(S) 33784, 33793, 33794, 33800, 33807, 33828, 33828, 33892, 33896, 33900, 33975, 34211, 34312, 34565, 34566, 34567, 34568, 34689, 34731, 34732, 35174

34347 (AD-A—163573/9/XAB) Properties of organic superconductors. Final report, September 1982-September 1983. Green, R.L.; Engler, E.M. (IBM Research Lab., San Jose, CA (USA)). Sep 1983. 23p. NTIS, PC A02/MF A01.

The major results were: 1. Discovery of a new class of organic superconductors based on the (BEDT-TTF) molecule. This discovery has proven to be very important since recent chemical modification of the (BEDT-TTF) compound has led to a superconducting transition temperature of 8K, quite high for an organic solid. This offers the possibility that superconductivity can be found at temperatures greater than inorganic materials. The characterization of the (BEDT-TTF)2X superconductors included transport, magnetic, and structural properties and these are discussed. 2. Measurement of the far-IR properties of $(TMTSF)_2$ ClO_4. These results proved that a large superconductivity gap does not exist in $(TMTSF)_2$ ClO_4, contrary to previous speculations and erroneous interpretation of data by other workers. This rules out the possibility of superconducting fluctuations in the (TMTSF)2X class of organic superconductors. 3. Observation of now features of the magnetic-field-induced transition in $(TMTSF)_2$ ClO_4. The field-induced-transition (FIT) is quite anomalous and appears to be unique in solid-state physics. The Hall effect and the magnetoresistance of $(TMTSF)_2$ ClO_4 was measured as a function of magnetic field up to 20T.

34348 (AD-A—164361/8/XAB) Study of dislocation motion in GaAs and Al/sub x/Ga/sub 1-x/As/GaAs devices. Kuesters, K.H.; De Cooman, B.D.; Carter, C.B. (Cornell Univ., Ithaca, NY (USA). Dept. of Materials Science and Engineering). Aug 1984. 10p. NTIS, PC A02/MF A01.

The microscopic mechanisms of the interaction of dislocations with interfaces in AlGaAs/GaAs devices and of dislocation motion in GaAs during electron irradiation were studied using TEM. The results demonstrate new features concerning the interaction of dislocations with heterojunctions. The in-situ TEM study of dislocation motion shows clearly the different mobility of alpha, beta, and screw dislocations. The migration of kinks is shown to be particularly affected by electron irradiation. In GaAs-based devices, such as semiconductor lasers and LEDs, dislocation climb and glide during device operation can cause the degradation of the device. Under intense electron-hole recombination rapid dislocation climb can lead to the development of a dislocation network in the device. Such networks are believed to originate preferentially at heterojunction interfaces. Dislocation glide has also been shown, by dislocation velocity measurements, to be enhanced by the recombination of electron-hole pairs. The present paper will briefly report two new studies aimed at understanding the microscopic nature of dislocation interactions with heterojunctions and of dislocation motion under electronic excitation. The first topic is the investigation of dislocation motion through heterojunctions between GaAs and $Al_xGa_{1-x}As$. The second topic is an in situ study of dislocation motion under electron irradiation in the TEM.

34349 (DOE/ER/45218—1) Interface properties and crystal-growth mechanisms. Progress report, July 1985-January 1986. Broughton, J.Q. (State Univ. of New York, Stony Brook (USA). Dept. of Materials Science). 13 Jan 1986. Contract FG02-85ER45218. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010846.

The pulsed heating of Si-vapor interfaces has been modelled for the close-packed (111) and open (100) faces. A Si (111)-melt interface has been quenched. Grain-boundary interfaces with melt have also been studied, along with properties of Si liquid. Pseudopotentials have been obtained for the electron-argon system. (DLC)

34350 (INIS-mf—10105, pp 92) Determination of NMR chemical shifts using external standards. Pokorny, J.; Bella, J.; Liptaj, T.; Malik, L. (Slovenska Akademia Vied, Bratislava, Czechoslovakia; Drug Research Institute, Modra, Czechoslovakia; Slovenska Vysoka Skola Technicka, Bratislava, Czechoslovakia. Chemickotechnologicka Fakulta). 1984. NTIS (US Sales Only), PC A02/MF A01. File Number DE86702155. (CONF-8406249—Vol.2-Absts.).

From 7. Czechoslovak spectroscopic conference and 8. CANAS; Ceske Budejovice, Czechoslovkia (18 Jun 1984).

34351 (Juel-Conf—54, pp 327-342) Borosilicate glass for the EUREX high-level wastes. Characterization and behaviour. Donato, A.; Gottardi, V.; Soraru, A.; Zhang Jifu. (ENEA, Casaccia, Italy; Padua Univ., Italy. Ist. di Chimica Industriale; Beijing Inst. of Nuclear Engineering, China). Jun 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE86752037. (CONF-8506114—).

From International seminar on radioactive waste products suitability for final disposal; Julich, F.R. Germany (10 Jun 1985).

A borosilicate glass composition named BEL-15 has been studied for the solidification of the MTR high-level wastes stored at the EUREX reprocessing plant. Its main physico-chemical characteristics have been reported, as well as the main results obtained in the characterization work. The glass mechanical strength has been determined according to two methods: the microindentation method and the impact test. During the glass leaching, performed according to the MCC-1 test using clay interstitial water as leachant, some crystal amounts seem to form over the glass surface, producing a sample weight increase after the test. The crystal nature has been investigated and some assumptions have been made.

34352 (Juel-Conf—54, pp 343-369) Methodology for evaluating the aqueous leach resistance of a glass used in a characterization study. Terki, A.; Pacaud, F.; Jacquet-Francillon, N.; Morlevat, J.P. (CEA Etablissement de la Vallee du Rhone, 30 - Bagnols-sur-Ceze, France; CEA Centre d'Etudes Nucleaires de Grenoble, 38, France). Jun 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE86752037. (CONF-8506114—).

From International seminar on radioactive waste products suitability for final disposal; Julich, F.R. Germany (10 Jun 1985).

In the course of a characterization study, comparative accelerated alterability measurements were conducted on active and inactive laboratory glasses under static and dynamic leaching conditions using a stainless steel 'Soxhlet' device. The effects of three basic parameters (leaching mode, pressure and temperature) were investigated. During the tests, the element and mass losses were noted together with the pH variation, and the surface layer was analyzed. The test results show that glass corrosion is not congruent, that each element reacts in a specific way, and that certain elements tend to remain in the interface layer.

34353 (Juel-Conf—54, pp 370-388) Uncertainty analysis on leaching rate measurements of nuclear waste glass. Suzuki, Atsuyuki; Umeki, Hiroyuki; Kiyose, Ryohei. (Tokyo Univ., Japan. Faculty of Engineering). Jun 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE86752037. (CONF-8506114—).

From International seminar on radioactive waste products suitability for final disposal; Julich, F.R. Germany (10 Jun 1985).

This paper is aimed at proposing a concept of conservative but not-unrealistic modeling to estimate a leaching rate, with emphasis on the effects of waste composition, temperature and glass-surface-area to water-volume ratio.

34354 (Juel-Conf—54, pp 414-432) Characterisation and quality control of hot pressed Synroc. Woolfrey, J.L.; Ramm, E.J. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Jun 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE86752037. (CONF-8506114—).

From International seminar on radioactive waste products suitability for final disposal; Julich, F.R. Germany (10 Jun 1985).

Procedures are being developed to determine the quality of the waste product during processing and the durability of the final waste form. The basic guidelines for the specification of the waste form composition and the process variables that effect Synroc performance are discussed. The physical property tests that are applicable for quality assurance during processing and the final characterization of the waste form are described. Typical results from these tests are presented. (orig./PW).

34355 (Juel-Conf—54, pp 433-444) **Characterisation of Synroc microstructure and durability and its influence on final disposal.** Myhra, S.; Segall, R.L.; Smart, R.S.C.; Stephenson, M.; Turner, P.S.; White, T.J. Jun 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE86752037. (CONF-8506114—).

From International seminar on radioactive waste products suitability for final disposal; Julich, F.R. Germany (10 Jun 1985).

Principal phases in Synroc C have been identified as zirconolite, zirkelite, polymignyte, perovskite and the hollandite, pyrochlore and magnetoplumbite structure types. Intermetallic alloy phases are also present. Investigation has established that Synroc C, like all multiphase ceramics, contains intergranular films, usually less than 30 angstrom wide. Detailed microstructural and surface analytical studies of leached Synroc C under hydrothermal conditions have revealed the alteration of the chemical environments of the different major phase elements and also of the high level waste elements. Changes in the composition of the surface have also been monitored in leached Synroc C. Mechanisms for the leaching and dissolution of Synroc are proposed.

34356 (Juel-Conf—54, pp 581-590) **Influence of solubility and insolubilisation on the release of radioactive products.** Lanza, F.; Bidoglio, G.; Zamorani, E. (Commission of the European Communities, Ispra, Italy. Joint Research Centre). Jun 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE86752037. (CONF-8506114—).

From International seminar on radioactive waste products suitability for final disposal; Julich, F.R. Germany (10 Jun 1985).

One of the difficulties in evaluating the waste forms is that their main characteristic, that means resistance to the leaching, must be referred to the situation in which the waste will be located. This is particularly true when the release of an element is limited not by the waste matrix degradation but by the solubility limit of the different species containing such an element. The most important parameters seem to be the concentration of complexing agents in the water surrounding the waste form, the Eh of the solution and the pH. Typical examples of these influences will be presented and discussed.

34357 (K/TS—11-796) **Synthetic carbon precursor materials.** Frame, B.J. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Mar 1986. Contract AC05-84OT21400. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86011584.

Synthetic carbon precursor systems offer advantages over natural petroleum and coal-tar pitch precursors in that they can reproducibly provide a material with a known and uniform composition. They also permit controlled modifications of the derived carbon's properties through variations in the precursor's properties and processing conditions. Extensive research efforts at Oak Ridge have been directed toward the production and characterization of synthetic carbon precursors and the correlations that exist between carbon precursor properties and the properties of the ultimate carbon. This report describes how synthetic carbon precursors can be used to tailor and develop reproducible carbon structures for advanced materials applications. The potential and capability for performing carbon material development at Oak Ridge is also described.

34358 (LBL—20847) **Domain structure of lanthanum modified lead titanate ceramics.** Demczyk, B.G. (California Univ., Berkeley (USA). Dept. of Materials Science and Mineral Engineering; Lawrence Berkeley Lab., CA (USA)). Aug 1985. Contract AC03-76SF00098. 94p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86011312.

The domain configurations in lanthanum modified lead titanate ferroelectric ceramics have been studied by transmission electron microscopy, in both the conventional and analytical modes. Results indicate a preponderance of [110], twin related 90° domains of equilibrium width approximately 400 A. This value is independent of grain size above a critical value and is consistent with values derived from consideration of elastic strain energy. Below this critical value (approximately 400 A), single domain grains are found. A domain wall energy of 10 ergs/cm^2 was calculated based on this observation. Such domains also occasionally display multiple twinning, also among [110]. In addition, [100], 180° domains are found, which display crystallographic misorientation of less than 0.5°. The reversibility and observed microstructure of the paraelectric to ferroelectric phase transformation strongly resembles that observed in martensite.

34359 (ORNL/CON—199) **Development of advanced thermal insulation for appliances. Progress report, July 1984-June 1985.** Yarbrough, D.W.; Weaver, F.J.; Graves, R.S.; McElroy, D.L. (Oak Ridge National Lab., TN (USA)). May 1986. Contract AC05-84OR21400. 50p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86011357.

Numerical simulations of the radial heat flow apparatus used to measure the apparent thermal conductivity (k/sub a/) of powders with high thermal resistance (R) showed that heat losses from the ends of the cylindrical specimen and core heater cause the k/sub a/ of the specimen to be greater than the true value. This effect is large when high-R powders are tested. A radial apparatus 91 cm in length, ORNL-5, was constructed and used to reduce uncertainties introduced by end losses. ORNL-5 was used to test mixtures of low-cost coarse fumed-silica particles and relatively uniform, but expensive, fine fumed-silica particles. R-values per inch (2.54 cm) in air near 7 have been measured for pure fumed-silica powders. The thermal resistances of mixtures of coarse and fine powders were determined in the range 290 to 340°K at atmospheric pressure. Results show that R per inch depends on density and that R-values per inch greater than 5 can be achieved with such mixtures. R-values for a mixture of nominal 7-nm fine silica and coarse silica have been measured as a function of pressure near 300°K, and R per inch greater than 40 has been achieved in vacuum (<10 Pa). Linear heat flow measurements on evacuated rectangular panels showed that R per inch for the panels dropped from 16.8 to 15.9 in two years.

34360 (ORNL/Sub—84-43366/2) **Transient heat transfer analysis and radiative properties measurements of porous thermal insulation.** Tong, T.W. (Kentucky Univ., Lexington (USA). Dept. of Mechanical Engineering). May 1986. Contract AC05-84OR21400. 83p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86011296.

A combined radiative and conductive heat transfer model that uses the two-flux equations for radiation exchange has been applied to analyze the transient heat transfer data obtained with the flat-screen tester at ORNL. The data included those for the National Bureau of Standards (NBS) transfer standard and the NBS 1450b fiberglass board. Predictions that deviated by no more than 0.2°C of the measured screen temperature rise were obtained. Results indicate that the model can be used in conjunction with the transient data to determine the thermophysical properties of porous insulations. Transient heat transfer through porous insulations with one diurnal temperature boundary condition has been investigated using the same combined heat transfer model. By comparing the accumulated heat flow at the boundaries to those predicted using a purely conductive model, differences as large as 40% were found for some conditions. Results for a thermal resistance defined in terms of time-integrated quantities were also obtained and compared with that defined for steady-state conditions. Radiative properties for the NBS transfer standard, NBS 1450b, Cab-O-Sil S-17 and the Degussa R-974 have been measured. Properties reported included the extinction coefficient, single scattering albedo and the back-scattered fraction for the former two materials and the extinction coefficient for the latter two materials.

34361 **(SAND—86-0031C) Microscopic calculation of critical layer thickness for coherently strained silicon-like structures.** Dodson, B.W. (Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 8p. (CONF-8605111—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86009853.

From Northeast regional meeting on semiconductor-based heterostructure interfacial structure and stability; Murray Hill, NJ, USA (1 May 1986).

Monte Carlo based microscopic techniques were used to study the stability of thin coherently strained layers of mismatched silicon-like semiconductor material grown on the (111) silicon surface. The atomic interaction used for this study is the Stillinger-Weber potential, modified to allow modelling of mismatched materials. Mismatched layers from 3 to 80 A thickness were considered. For layers greater than about 20 A thickness, the critical layer thickness is accurately described by the continuum theory of Matthews and Blakeslee. For thinner layers, however, the strain energy associated with misfit dislocations becomes greater than the continuum value, resulting in smaller critical layer thickness, to the extent that critical mismatch as a function of layer thickness becomes nonmonotonic for the thinnest films considered.

34362 **A kinetic model for plasma etching silicon in a SF_6/O_2 RF discharge.** Anderson, H.M.; Merson, J.A.; Light, R.W. (Department of Chemical and Nuclear Engineering, University of New Mexico, Albuquerque, NM 87131). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **PS-14**: No. 2, vp(Apr 1986).

Time-dependent Boltzmann electron distribution calculations have been made at constant power and pressure in a SF_6/O_2 plasma with a varying oxygen mole fraction. The results show that as the oxygen fraction increases in a SF_6/O_2 plasma, the number of high-energy electrons in the tail of the electron distribution and the mean electron energy both increase significantly while the plasma is kept at the same reduced electric field E/N. Rate coefficients have been computed for the electron kinetic processes of these plasma and merged with a kinetic equilibrium model for the plasma etch process, including neutral gas-phase chemistry, ion chemistry, and surface reactions. Model simulations show good agreement with experimental results for SF_6/O_2 etching of polysilicon and demonstrate that the anisotropic character of dilute SF_6 plasma etching is related to the shift in the electron distribution with increasing oxygen fraction. Competition between F and O species for adsorption to silicon etching sites is also shown to be a factor in determining etch rates, but this competition is not significant until very large (> 80 percent) oxygen concentrations are present. Ionixation rates and ion transport to the surface are shown to be much more important. The model simulations provide a rationale for explaining the very high etch rates observed at low SF_6 partial pressures and the increasing anisotropic etch character with greater oxygen dilution of SF_6.

34363 **Vacuum vapor deposition gun assembly.** Zeren, J. D. (to US DOE). US Patent 4,561,382. 31 Dec 1985. Filed date 22 Nov 1983. vp.

PAT-APPL-554414.

A vapor deposition gun assembly includes a hollow body having a cylindrical outer surface and an end plate for holding an adjustable heat sink, a hot hollow cathode gun, two magnets for steering the plasma from the gun into a crucible on the heat sink, and a shutter for selectively covering and uncovering the crucible.

34364 **Precisely modifying predetermined surface layers of a workpiece by cluster ion impact therewith.** Friedman, L.; Buehler, R. J.; Ledbetter, M.; Matthew, M. J. (to The United States of America as represented by the United States Department of Energy). US Patent 4,559,096. 17 Dec 1985. Filed date 25 Jun 1984. vp.

PAT-APPL-623874.

A method of precisely modifying a selected area of a workpiece by producing a beam of charged cluster ions that is narrowly mass selected to a predetermined mean size of cluster ions within a range of 25 to 10^6 atoms per cluster ion, and accelerated in a beam to a critical velocity. The accelerated beam is used to impact a selected area of an outer surface of the workpiece at a preselected rate of impacts of cluster ions/cm²/sec. in order to effect a precise modification in that selected area or the workpiece.

34365 **Method of forming thermally stable high-resistivity regions in n-type indium phosphide by oxygen implantation.** Thompson, P.E.; Dietrich, H.B. (to Dept. of the Navy, Washington, DC). US Patent Application 6-808,699. 12 Dec 1985. 13p. NTIS, PC A02/MF A01.

Objects of this invention are: to form high-temperature stable isolation regions in InP; to provide InP wafers that allow greater flexibility in the design and fabrication of discrete devices; to provide new and improved InP semiconductor devices in n-type InP; to provide high-resisitivity isolation regions in InP; to extend the usefulness of damage-induced isolation in n-type InP by making possible processes in which the isolation implantation precedes the alloying of ohmic contacts; and to provide n-type InP substrates without unwanted conductive layers. The above and other object are realized by an InP wafer comprising a S.I. InP substrate; a n-type InP active layer disposed on the substrate; and oxygen ion implanted isolation regions disposed in the active layer. The S.I. InP dopant may comprise either Fe or Cr.

34366 **Acoustic resonator with Al electrodes on an AlN layer and using a GaAs substrate.** Kline, G. R.; Lakin, K. M. (to The United States of America as represented by the United States Department of Energy). US Patent 4,556,812. 3 Dec 1985. Filed date 18 Jul 1984. vp.

PAT-APPL-632165.

A method of fabricating an acoustic wave resonator wherein all processing steps are accomplished from a single side of said substrate. The method involves deposition of a multi-layered Al/AlN structure on a GaAs substrate followed by a series of fabrication steps to define a resonator from said composite. The resulting resonator comprises an AlN layer between two Al layers and another layer of AlN on an exterior of one of said Al layers.

34367 **Glass capable of ionic conduction and method of preparation.** Susman, S.; Boehm, L.; Delbacq, C. J.; Volin, K. J. (to The United States of America as represented by the United Department of Energy). US Patent 4,542,108. 17 Sep 1985. Filed date 21 Jul 1983. vp.

PAT-APPL-515835.

Sulfide glasses capable of conducting alkali metal ions are prepared from a nonmetal glass former such as GeS_2, B_2S_3 and SiS_2 in mixture with a glass modifier such as Na_2S or another alkali metal sulfide. A molten mixture of the constituents is rapidly quenched to below the glass transition temperature by contact with a metal mold. The rapid quench is sufficient to prevent crystallization and permit solidification as an amorphous solid mixture. An oxygen-free atmosphere is maintained over the mixture to prevent oxidation. A new glass system of (l-X) Na_2O:XB_2S_3 is disclosed.

34368 **Electropositive bivalent metallic ion unsaturated polyester complexed polymer concrete.** Sugama, T.; Horn, W. H.; Kukacka, L. E. (to The United States of America as represented by the United States Department of Energy). US Patent 4,540,726. 10 Sep 1985. Filed date 13 May 1983. vp.

PAT-APPL-494484.

Quick setting polymer concrete compositions with excellent structural properties are disclosed; these polymer concrete compositions are mixtures of unsaturated polyesters and crosslinking monomers together with appropriate initiators and promoters in association with aggregate, which may be wet, and with a source of bivalent metallic ions.

34369 **Thermoluminescence kinetics in materials exposed to the low doses applicable to dating and dosimetry.** Levy, P.W. (Brookhaven National Lab., Upton, NY, USA). *Nuclear Tracks;* **10**: No. 4-6, 547-556(1985). (CONF-8409192—).

From 4. international seminar on TL and ESR dating; Worms, F.R. Germany (1 Sep 1984).

Thermoluminescence (TL) kinetics have been investigated for low dose situations applicable to dating, dosimetry, and recent geological deposits. Studied were the general one-trap kinetic equa-

tion, which reduces to the well known 1st and 2nd order kinetic equations when various assumptions apply, and the interactive kinetic equations, which describe TL in materials exhibiting more than one glow peak. In materials with one glow peak the peak area varies linearly with dose; however, peak height is not linear with dose unless the TL obeys 1st order kinetics at all doses. In materials with two or more glow peaks neither peak height nor peak area varies linearly with dose, except in special situations. In fact, many peak height vs. dose curves will be supralinear with the initial low-slope region occurring at relatively low doses. These considerations indicate: (1) dating and dosimetry techniques based on assumed linear peak height vs. dose curves will usually underestimate the accumulated dose; (2) dating techniques can be improved and/or made more reliable by determining the TL kinetics of the glow peaks measured.

34370 **The growth and nucleation of mixed-salt aerosols.** Tang, I.N.; Munkelwitz, H.R. (Brookhaven National Lab., Upton, NY 11973). pp 6-8 of Proceedings of the international symposium workshop on particulate and multi-phase processes. Ariman, T.; Veziroglu, T.N. Coral Gables, FL; Clean Energy Research Institute (1985). (CONF-850406—).

From International symposium and workshop on particulate and multi-phase processes and the 16th annual meeting of the Fine Particle Society; Miami Beach, FL, USA (22 Apr 1985).

The experimental technique recently developed for studying droplet growth and evaporation are used in the present work to investigate the deliquescence and crystal nucleation of mixed-salt aerosols. The technique involves the levitation of a single micrometer-sized particle in a quadrupole cell, which can be evacuated to $\approx 10^{-7}$ torr and back filled with water vapor at controlled temperature and pressure. The mass changes during droplet growth and evaporation are continuously monitored with the DC voltage that is needed to maintain the particle in the electrical null point of the cell. Data are presented for the NaCl-KCl mixed-salt system, showing the stage-wise phase transformation both at deliquescence and at crystallization. Critical supersaturation and water activity at the onset of solute nucleation are determined as a function of composition. The interfacial free energy and size of the critical nucleus are deduced using nucleation theory and electrolyte solution thermodynamics.

34371 **Application of molecular dynamics to macroscopic particles.** Walton, O.R. (Lawrence Livermore National Lab., CA). *International Journal of Engineering Science;* **22**: No. 8-10, 1097-1107(1984). Contract W-7405-ENG-48.

The development of molecular dynamics research is briefly reviewed with emphasis on current non-equilibrium computational techniques used to calculate transport coefficients in systems of polyatomic molecules. Many of the numerical methods and numerical - experiment evaluation techniques of that field could be adapted to macroscopic granular material studies. There are, however, significant differences between macroscopic and molecular interactions - differences that considerably modify some of the computational methods and also the interpretation of the calculational results. Macroscopic particles interact with non-conservative interaction forces. Macroscopically available energy is lost from the system during most dynamic interactions - through plastic deformation, friction and breakage. Cundall and Strack are using simplified models of the interaction forces acting between essentially rigid macroscopic particles to study quasi-static deformations in assemblies of two-dimensional circular particles. The authors are using somewhat similar two-dimensional models in a study of non-equilibrium shearing flow of granular materials. Several verification calculations and tests have confirmed the ability of these computer models to predict the dynamic interactions of macroscopic particles. Preliminary results from shearing flow calculations and corresponding laboratory tests are also in qualitative agreement. Plans for a quantitative study of shear stress dependence on shear rate and other parameters are discussed. 42 references, 2 figures.

34372 **Glass transition temperature of Na_2O x 3 SiO_2 glasses with high water content.** Tomozawa, M.; Takata, M.; Acocella, J.; Watson, E.B.; Takamori, T. (Rensselaer Polytechnic Institute, Troy, NY). *Yogyo Kyokai Shi;* **91**: No. 8, 377-383(1983). Contract AC02-79ER10453.

Na_2O x 3 SiO_2 glasses with various water contents (up to ~8 wt%) were prepared under high pressure, hydrothermal conditions and their glass transition temperatures (T/sub g/) were measured by DTA. Exsolution of dissolved water occurs at temperature above T/sub g/, and is accompanied by foaming. Both the glass transition temperature and the foaming temperature decrease with increasing water content. The change of the glass transition temperature with water content was compared with various equations applicable to polymer plasticizers, and was found to be best described by an equation which takes the different contributions of hydroxyl ions and molecular water into account. It was concluded that the hydroxyl ions lower T/sub g/ drastically while the molecular water lowers it only slightly by merely diluting the glasses. 31 references, 7 figures.

34373 **Diffusive motion of alkali atoms in graphite: a quasielastic neutron scattering study.** Zabel, H.; Magerl, A.; Rush, J.J.; Dianoux, A.J. (Univ. of Illinois, Urbana). *Materials Research Society Symposia Proceedings;* **20**: 289-291(1983). Contract AC02-76ER01198.

The authors have studied the diffusive motion of alkali atoms in thermodynamic equilibrium in RbC_{24} by quasielastic neutron scattering. The neutron spectra show Lorentzian line profiles. The widths increase with increasing temperature. In addition a de Gennes narrowing is observed at $Q=1.2\ A^{-1}$, which coincides with the first peak in the intercalant structure factors. The narrowing becomes more pronounced at higher temperatures in contrast to a normal liquid. The data can be interpreted by the motion of clusters of alkali atoms rather than by a liquid type motion. This adds a dynamical aspect to the floating solid as described by Nelson and Halperin for the melting of a 2-dimensional solid. 7 references, 1 figure.

40 CHEMISTRY

4001 Analytical And Separations Chemistry

REFER ALSO TO CITATION(S) 33494, 33754, 33787, 33796, 33826, 34452, 34452, 34584, 34694, 34697, 34710

34374 **(AD-A—163946/7/XAB) High-resolution coherent anti-Stokes Raman spectroscopy of deuterium gas. Master's thesis.** Russell, D.A. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Dec 1985. 74p. (AFIT/GEO/ENP—85D-4). NTIS, PC A04/MF A01.

Coherent anti-Stokes Raman spectroscopy (CARS) is a third-order nonlinear optical mixing process primarily used to probe gases. Two laser beams interact with the medium being studied producing a weak, third beam with a higher frequency than either of the lasers. High resolution cw coherent anti-Stokes Raman spectroscopy (CARS) was performed in molecular deuterium gas. Single-mode argon-ion and ring-dye lasers were used to make accurate measurements of the Raman linewidths of the Q(0) through Q(4) transitions. These lines were examined at room temperature at pressures ranging from 0.35 to 20 atmospheres. The pressure-broadening coefficient and the self-diffusion coefficient of each line were obtained in this study and compared with other work. Additionally, the transition frequency of each line was measured and the frequency shift coefficients were obtained.

34375 **(AERE-M—3480) Controlling a sample changer using the integrated counting system.** Deacon, S.; Stevens, M.P. (UKAEA Atomic Energy Research Establishment, Harwell. Instrumentation and Applied Physics Div.). Jun 1985. 8p. H.M.Stationery Office, London, price Pound 4.00.

Control of the Sample Changer from a counting system can be achieved by using a Scaler Timer type 6255 and Sample Changer Control Interface type 6263. The interface used, however, has quite complex circuitry. The application therefore lends itself to the use of another 6000 Series module-the Integrated Counting System (ICS). Using this unit control is carried out through a control program written in BASIC for the Commodore PET (or any other device with an IEEE-488 interface). The ICS then controls the sample changer through an interface unit which is relatively simple. A brief description of how ICS controls the sample changer is

given. The control program is then described; first the running options are given, followed by a program description listing and flowchart.

34376 (BARC—1269) Spectroscopy Division progress report for January 1983-December 1984. Dixit, R.M. (ed.). (Bhabha Atomic Research Centre, Bombay (India)). 1985. 233p. NTIS (US Sales Only), PC A11/MF A01. File Number DE86702154.

The Research and Development (R and D) activities of the Spectroscopy Division of the Bhabha Atomic Research Centre, Bombay, during the period from January 1983 to December 1984 are reported. The main thrust of the activities of the Division is directed towards meeting the spectrochemical analytical requirements of the nuclear energy programmes and the related R and D projects of the Department of Atomic Energy. These activities are described in the form of summaries grouped under the headings: (1) analyses by optical emission, X-ray fluorescence, X-ray excited optical luminescence and other techniques, (2) atomic, molecular and solid state spectroscopy, (3) optics and thin films, and (4) electronic instrumentation. Two feature articles which are included in the report bring out the salient features of X-ray absorption fine structure spectroscopy (EXFAS) and laser spectroscopic techniques for trace analysis and describe the Division's efforts in setting up facilities to carry out work in these emerging fields. Other activities of the Division are teaching trainees and guiding research leading to M.Sc. and Ph.D. degrees. A list of papers published in journals and papers presented at conferences, symposia etc. by the staff-members of the Division is given. A divisional staff chart is also given.

34377 (CEA-CONF—8263) High-gradient electromagnetic separator with continuous slurry extraction. Dolle, L. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI)). Apr 1986. 8p. (CONF-8604160—1). NTIS (US Sales Only), PC A02/MF A01. File Number DE86751887.

From 4. world filtration congress; Ostend, Belgium (22 Apr 1986).

This kind of separator is operating without matrix in a cascade arrangement of conventional electromagnets. It is most suitable for continuous extraction of paramagnetic particulate solids in liquid suspensions. The water-cooled coils are supported by an iron-yoke with an adjustable air-gap. A one-stage device of laboratory size has been worked out in order to achieve measurements of the magnetic field intensities distributions. Then efficiency measurements were first carried out with a reference magnetite particles suspension in water, without sludge bleeding. As representatives of paramagnetic solids, manganese dioxide, copper oxide and a ruthenium oxide colloid in water are chosen, at concentrations ranging from 100 to 2000 ppm. Efficiencies were measured with continuous and periodical sludge bleedings. Results of such measurements are discussed.

34378 (CONF-860425—23) Future directions for separation science in nuclear and radiochemistry. Pruett, D.J. (Oak Ridge National Lab., TN (USA)). 1986. Contract AC05-84OR21400. 28p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86009498.

From 191. American Chemical Society national meeting; New York, NY, USA (13 Apr 1986).

Solvent extraction and ion exchange have been the most widely used separation techniques in nuclear and radiochemistry since their development in the 1940s. Many successful separations processes based on these techniques have been used for decades in research laboratories, analytical laboratories, and industrial plants. Thus, it is easy to conclude that most of the fundamental and applied research that is needed in these areas has been done, and that further work in these "mature" fields is unlikely to be fruitful. A more careful review, however, reveals that significant problems remain to be solved, and that there is a demand for the development of new reagents, methods, and systems to solve the increasingly complex separations problems in the nuclear field. Specifically, new separation techniques based on developments in membrane technology and biotechnology that have occurred over the last 20 years should find extensive applications in radiochemical separations. Considerable research is needed in such areas as interfacial chemistry, the design and control of highly selective separation agents, critically evaluated data bases and mathematical models, and the fundamental chemistry of dilute solutions if these problems are to be solved and new techniques developed in a systematic way. Nonaqueous separation methods, such as pyrochemical and fluoride volatility processes, have traditionally played a more limited role in nuclear and radiochemistry, but recent developments in the chemistry and engineering of these processes promises to open up new areas of research and application in the future.

34379 (DOE/ER/10946—5-Pt.1) Mechanism of flow through compressible, porous beds in sedimentation, filtration, centrifugation, and deliquoring. Second progress report, Part 1, May 1985-April 1986. Tiller, F.M. (Houston Univ., TX (USA). Dept. of Chemical Engineering; Martin Marietta Labs., Baltimore, MD (USA)). 25 Apr 1986. Contract AS05-81ER10946. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010920.

During the past year, we have continued our efforts to develop a unified approach toward the solution of problems in planar and radial pressure filtration, gravity filtration, batch settling, continuous thickening, centrifugal filtration, hydraulic deliquoring, and mechanical expression. The chief theoretical contributions were related to the development of a generalized procedure for solving problems in solid-liquid separation. 3 refs., 7 figs.

34380 (DOE/ER/10946—5-Pt.2) Mechanism of flow through compressible, porous beds in sedimentation, filtration, centrifugation, and deliquoring. Second progress report, Part 2, May 1985-April 1986. Tiller, F.M. (Houston Univ., TX (USA). Dept. of Chemical Engineering). 25 Apr 1986. Contract AS05-81ER10946. 73p. NTIS, PC A04. File Number DE86011091.

This report describes work performed at Martin Marietta Laboratories in support of a program at the University of Houston designed to advance the studies of Solid-Liquid Separation. The work described herein relates to cake filtration and initial stages of filtration using low concentratios. The procedures were performed during the period of May 1, 1985 to March 14, 1986. The objective this year has been to expand on the determination of how porosity and resistance may vary with thickness in cake filtrations and the manner in which particles pack at the medium/cake interface. In order to do so, the following conditions were used: constant pressure; various slurry concentrations; various amounts of slurry filtered; use of both flocculated and stable slurries; various sizes of particles filtered; and observation of particles under a microscope and telescope. 8 refs., 14 figs.

34381 (DOE/ER/13175—8) Study of Micellar-Enhanced Ultrafiltration. Progress report, March 1, 1985-February 28, 1986. Scamehorn, J.F.; Christian, S.D. (Oklahoma Univ., Norman (USA)). Oct 1985. Contract AS05-84ER13175. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011463.

The feasibility of Micellar-Enhanced Ultrafiltration (MEUF) to remove dissolved organics from water has been established. One of the first tasks was to determine the best surfactant to use in MEUF for various situations. From a thorough analysis of the properties and characteristics of a variety of surfactants, combined with preliminary runs with several surfactants, cationic surfactants were determined to be the best surfactant for general use in MEUF. Further, cetylpyridinium chloride was identifid as a near-optimum surfactant in most applications. Therefore, all further studies reported used this surfactant. Elimination of surfactant type as a variable permits more detailed investigation of other important variables. A major effort has been made to develop techniques for measuring the extent of solubilization of organic solutes by aqueous micellar systems. An important accomplishment during the past year has been the development of the so-called semi-equilibrium dealysis (SED) technique for studying solubilization.

34382 (INIS-BR—461, pp 71) **Thin-films preparation.** Costa, V.L. da. 1984. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. File Number DE86702106.

In Annual technical report of Nuclear Engineering Institute - Physics Department - 1984.

34383 (INIS-mf—10111, pp 14-15) **Comparison of calibration standards preparation by fixing into silica gel and by washing from quartz ampoules.** Jiranek, V. (Vyzkumny Ustav Potravinarskeho Prumyslu, Prague, Czechoslovakia). May 1985. (In Czech). NTIS (US Sales Only), PC A03/MF A01. File Number DE86701997. (CONF-8505256—Absts.).

From IAA conference on instrumental activation analysis; Klucenice, Czechoslovakia (12 May 1985).

34384 (INIS-mf—10111, pp 16) **Study of composition of ancient bronzes using radionuclide X-ray fluorescence analysis.** Frana, J.; Mastalka, A. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderne Fyziky). May 1985. (In Czech). NTIS (US Sales Only), PC A03/MF A01. File Number DE86701997. (CONF-8505256—Absts.).

From IAA conference on instrumental activation analysis; Klucenice, Czechoslovakia (12 May 1985).

34385 (INIS-mf—10111, pp 18) **Use of neutron activation analysis in studies of leaching of emissions.** Obrusnik, I.; Horakova, J. (Ustav Jaderneho Vyzkumu CSKAE, Rez, Czechoslovakia). May 1985. (In Czech). NTIS (US Sales Only), PC A03/MF A01. File Number DE86701997. (CONF-8505256—Absts.).

From IAA conference on instrumental activation analysis; Klucenice, Czechoslovakia (12 May 1985).

34386 (INIS-mf—10111, pp 19) **Applicability of activation analysis in solving problems in sugar factories.** Mastalka, A.; Frana, J. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderne Fyziky). May 1985. (In Czech). NTIS (US Sales Only), PC A03/MF A01. File Number DE86701997. (CONF-8505256—Absts.).

From IAA conference on instrumental activation analysis; Klucenice, Czechoslovakia (12 May 1985).

34387 (INIS-mf—10111, pp 20) **Neutron activation analysis and atomic absorption spectrometry used to study cadmium and zinc levels in the environment and in human tissues.** Kucera, J.; Soukal, L.; Cikrt, M.; Lepsi, P.; Tichy, M. (Ustav Jaderneho Vyzkumu CSKAE, Rez, Czechoslovakia; Institut Hygieny a Epidemiologie, Prague, Czechoslovakia). May 1985. (In Czech). NTIS (US Sales Only), PC A03/MF A01. File Number DE86701997. (CONF-8505256—Absts.).

From IAA conference on instrumental activation analysis; Klucenice, Czechoslovakia (12 May 1985).

34388 (INIS-mf—10111, pp 21) **Monitoring changes in selected trace elements in dependence on glucose tolerance by the NAA method.** Havelka, J.; Kvicala, J.; Roehling, S.; Zamrazil, V. (Vyzkumny Ustav Endokrinologicky, Prague, Czechoslovakia). May 1985. (In Czech). NTIS (US Sales Only), PC A03/MF A01. File Number DE86701997. (CONF-8505256—Absts.).

From IAA conference on instrumental activation analysis; Klucenice, Czechoslovakia (12 May 1985).

34389 (INIS-mf—10111, pp 22) **Monitoring age dependent concentrations of selected trace elements in serum and hair by the NAA method.** Kvicala, J.; Havelka, J.; Roehling, S.; Vana, S.; Zamrazil, V. (Vyzkumny Ustav Endokrinologicky, Prague, Czechoslovakia). May 1985. (In Czech). NTIS (US Sales Only), PC A03/MF A01. File Number DE86701997. (CONF-8505256—Absts.).

From IAA conference on instrumental activation analysis; Klucenice, Czechoslovakia (12 May 1985).

34390 (INIS-mf—10111, pp 25) **Determination of iodine concentration in primary circuit coolant of WWER-440 nuclear power plant.** Burclova, J. (Vyskumny Ustav Jadrovych Elektrarni, Jaslovske Bohunice, Czechoslovakia). May 1985. (In Czech). NTIS (US Sales Only), PC A03/MF A01. File Number DE86701997. (CONF-8505256—Absts.).

From IAA conference on instrumental activation analysis; Klucenice, Czechoslovakia (12 May 1985).

34391 (INIS-mf—10111, pp 33) **Determination of specific ^{226}Ra activity of building materials.** Kominek, A. (Vyzkumny Ustav Stavebnich Hmot, Brno, Czechoslovakia). May 1985. (In Czech). NTIS (US Sales Only), PC A03/MF A01. File Number DE86701997. (CONF-8505256—Absts.).

From IAA conference on instrumental activation analysis; Klucenice, Czechoslovakia (12 May 1985).

34392 (INIS-mf—10111, pp 17) **Preparation and properties of hydrated antimony pentoxide for selective sodium separation in neutron activation analysis.** Kucera, J.; Tympl, M.; Faltejsek, J. (Ustav Jaderneho Vyzkumu CSKAE, Rez, Czechoslovakia). May 1985. (In Czech). NTIS (US Sales Only), PC A03/MF A01. File Number DE86701997. (CONF-8505256—Absts.).

From IAA conference on instrumental activation analysis; Klucenice, Czechoslovakia (12 May 1985).

34393 (INP—1187/AP) **On the measurment of specific energy of coals by means of ^{12}C determination using a correlation method.** Cywicka-Jakiel, T.; Bogacz, J.; Czubek, J.A.; Dabrowski, J.M.; Loskiewicz, J.; Zazula, J.M. (Institute of Nuclear Physics, Krakow (Poland)). 1982. 28p. NTIS (US Sales Only), PC A03/MF A01. File Number DE86702156.

The most important industrial property of coal is its gross specific energy (combustion heat). It depends mainly on carbon concentration in coal. We propose to measure the carbon or more precisely, its ^{12}C content using the (n,n'γ) reaction in which 4.43 MeV gamma rays are emitted. We are using the correlation technique which can be used in high background measurements. The idea of correlation type measurement necessitates the existence of a reaction chain with primary and secondary radiations emitted and registered. By measuring the correlation or covariance function PHI we can obtain a measure of the number of excited ^{12}C nuclei i.e. a value which is connected to the carbon concentration. The dependence of PHI/t ratio (t being the sampling interval time) on carbon concentration shows a clear increase of the PHI/t value with carbon content. The relative standard deviations for different points vary from 1.3 to 4.4%. The preliminary results presented show that with improved experimental techniques this method can find application in industrial coal combustion heat measurements.

34394 (INS-R—322) **Hot shot reduction of water to hydrogen for isotopic analysis.** Stanley, K.; Lyon, G.L.; Stewart, M.K. (Department of Scientific and Industrial Research, Lower Hutt (New Zealand). Inst. of Nuclear Sciences). Feb 1984. 11p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86702164.

A simple new technique for quantitative reduction of water to hydrogen gas for isotopic analysis is described. Individual pyrex glass tubes are used as both reaction vessels (for the reaction of zinc shot with water to give hydrogen), and sample bottles (to transfer hydrogen to the mass spectrometer for analysis). The technique is based on that reported by Coleman et al. (1982), but we have added an additional step, in which the zinc shot and tube is heated to the reaction temperature and the resultant gases are pumped away before the water sample is admitted. Results show good precision and memory effects are almost eliminated.

34395 (INS-R—330) **Diffusion profiles of fluorine in archaeological bones and teeth. Their use as a possible dating method.** Nelson, P.H. (Department of Scientific and Industrial Research, Lower Hutt (New Zealand). Inst. of Nuclear Sciences). Jun 1984. 20p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86702159.

Measurements of radial fluorine profiles in bone and teeth sections with a nuclear microprobe show that the distribution is due to diffusion of fluoride ions inward from any exposed surface. Assuming simple diffusion and constant environment, the profile shape depends only on the parameter Dt/a^2 (D=diffusion constant, t=time, a=radius of bone/teeth). Three computer programs have been written to allow visual comparison of data with theoretical diffusion curves. Use of these programs has shown that experimental profiles follow closely the predictions of simple diffusion theory. (Although the diffusion constant may depend on concentration and species to a lesser extent). A preliminary value of D (2.74 +- 0.4) x 10^{-4}/ sq. mm/y was deduced from radiocarbon dated Moa bones (age 400-16,200 yr B.P.). Preliminary investigations indicate that the diffusion constant in tooth dentine is approximately the same as in bone. These results indicate that a dating method using the computer programs should be possible for bones ranging in age from a few years to perhaps millions of years and that dating teeth should also be possible.

34396 **(KAERI/MR—70/84) Service activities of chemical analysis division.** Eom, Tae Yoon; Suh, Moo Yul; Lee, Chang Hun; Han, Sun Ho. (Korea Advanced Energy Research Inst., Daeduk (Republic of Korea)). Mar 1985. 44p. (In Korean). NTIS (US Sales Only), PC A03/MF A01. File Number DE86702165.

The support activities of chemical analysis division for the year of 1984 are described. A sum of 2445 samples requested from the facilities and laboratories were analyzed with the methods modified and adopted in the laboratory from 1977 to 1983. A study on the separation and determination of the trace amounts of rare earth elements in nuclear materials was carried out, and various experimental conditions were established.

34397 **(ORNL—6236) Analytical Chemistry Division annual progress report for period ending December 31, 1985.** Shultz, W.D. (Oak Ridge National Lab., TN (USA)). May 1986. Contract AC05-84OR21400. 90p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86011350.

Progress reports are presented for the four major sections of the division: analytical spectroscopy, radioactive materials laboratories, inorganic chemistry, and organic chemistry. A brief discussion of the division's role in the Laboratory's Environmental Restoration and Facilities Upgrade is given. Information about quality assurance and safety programs is presented, along with a tabulation of analyses rendered. Publications, oral presentations, professional activities, educational programs, and seminars are cited.

34398 **(PNL-SA—12937) Mechanism of solute retention in supercritical fluid chromatography.** Yonker, C.R.; Smith, R.D.; Wright, B.W. (Pacific Northwest Labs., Richland, WA (USA)). Mar 1985. Contract AC06-76RL01830. 8p. (CONF-850942—55). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011325.

From 190. American Chemical Society national meeting; Chicago, IL, USA (8 Sep 1985).

Retention in supercritical fluid chromatography (SFC) is determined by solute solubility in the fluid and solute interaction with the stationary phase. The functional relationship between retention and pressure at constant temperature has been described by Van Wasen and Schneider. The trend in retention is shown to depend on the partial molar volume of the solute in the mobile and stationary phase coupled with the isothermal compressibility of the fluid mobile phase. The purpose of this work was to determine the relationship between solubility and retention. A thermodynamic model was developed which predicts the trend in retention as a function of pressure, given the solubility of the solute in the fluid mobile phase. From this model, solute retention behavior can be examined by theory and experiment in order to gain some insight into the complicated dependence of retention on the thermodynamic and physical properties of the solute and the fluid, providing a basis for consideration of more subtle effects unique to SFC. 15 refs., 2 figs.

34399 **(RFP—3963) Pyrochemical separations chemistry of plutonium.** Bynum, R.V.; Navratil, J.D. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). [1986]. Contract AC04-76DP03533. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010809.

The recovery and purification of plutonium involves interesting chemistry. Currently in use are several high temperature processes based on redox reactions. These processes include direct oxide reduction which uses calcium to reduce the oxide to the free metal and electrorefining which is used as a final purification step. The chemical research group at Rocky Flats is currently investigating the use of an aluminum/magnesium alloy to remove the ionic plutonium from the salts used in the above named processes. The results of this study along with an overview of pyrochemical plutonium processing chemistry will be presented.

34400 **(UCRL—93538) Micro-tomography using synchrotron radiation.** Johnson, Q.C.; Kinney, J.H.; Bonse, U.; Nichols, M.C.; Nusshardt, R.; Brase, J.M. (Lawrence Livermore National Lab., CA (USA); Dortmund Univ. (Germany, F.R.). Abt. Physik; Sandia National Labs., Livermore, CA (USA)). 9 Apr 1986. Contract W-7405-ENG-48. 8p. (CONF-860445—13). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010982.

From Materials Research Society spring meeting; Palo Alto, CA, USA (15 Apr 1986).

This paper discusses the results of recent experiments at Stanford Synchrotron Radiation Laboratory (SSRL) and Hamburger Synchrotronstrahlungslabor (HASYLAB) which were designed to explore the feasibility of using synchrotron radiation in high-resolution, computerized, critical-absorption tomography. The results demonstrate that it is possible, using absorption-edge differencing, to identify adjacent elements in the periodic table with high sensitivity. Furthermore, by using the fine structure in the absorption spectra, it is possible to distinguish between regions of different chemical states. Methods of using synchrotron radiation for high-resolution, three-dimensional chemical-state mapping in small samples are discussed.

34401 **ICP argon emission in the near infrared 1-2 μm by high resolution Fourier transform spectrometry.** Faires, L.M.; Palmer, B.A.; Engleman, R. Jr.; Niemczyk, T.M. (Los Alamos National Lab., NM). *Spectrochimica Acta, Part B: Atomic Spectroscopy;* **40B**: No. 4, 545-551(1985).

The emission characteristics of the inductively coupled plasma in the near infrared spectral region from 0.9 to 2.0 μm have been recorded by high resolution Fourier transform spectrometry. This region contains many strong atomic argon lines. The 109 lines with signal-to-noise ratio greater than four in the observed spectrum are identified and reported here with wavenumber accuracy on the order of 0.001 cm^{-1}. Also reported are relative intensities and line widths. This information is useful for determining spectral interferences to be expected in the development of analytical applications for the ICP in the near infrared. 22 references, 2 figures, 3 tables.

34402 **A user-oriented laboratory data entry computer system designed to reduce errors.** Peloquin, R.A. (Pacific Northwest Lab., Richland, WA). pp 7025-7030 of Computer applications in health physics. Kathren, R.L.; Higby, D.P.; McKinney, M.A. Richland, WA; Health Physics Society (1984). (CONF-840202—).

From 17. midyear topical meeting of the Health Physics Society; Pasco, WA, USA (5 Feb 1984).

Data entry computer programs that focus on the user-system interface can reduce error, save time, and optimize personnel resources. Feed-back from the potential users during the task analysis and throughout the development stage should direct the formation of the computer code. Checking and verification of data, reduction of keystrokes, and in-place instructions are some of the techniques that should be utilized. These design principles and techniques were used during the development of ENTRY, a data entry computer program used to record data (e.g., sample weights, radiochemical analyses) for a long-term field and laboratory study. Extensive data must be collected each year from each of the more than 350 experimental plots used in the study. The data is entered on a MINC-11/ sup(b)/ microcomputer with two disk drives and less than eight kilobytes of usable memory. Despite the memory restriction, the program demonstrates a wide range of techniques which make it easy to use and consequently reduces the occurrence of errors.

34403 (Y/TR—86/3) Permeation membrane-type distiller. Fujita, K. (Oak Ridge Y-12 Plant, TN (USA)). [1986]. Contract AC05-84OS21400. Translation of Japanese Patent Application 60-187305, September 24, 1985. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86011153.

The permeation membrane-type distiller is characterized by and is comprised of a condensed liquid channel positioned parallel to and between a permeation membrane that borders a high-temperature raw liquid channel and a condensed heat transfer plate that borders a cooling liquid channel, wherein said condensed heat transfer plate has a wavelike cross section whose ridges come close to said permeation membrane and, at the same time, a screen is positioned between said condensed heat transfer plate and said permeation membrane in such a way that it comes in contact with said membrane.

34404 (Y/TR—86/5) Thermopervaporation system. Kimura, Takashi; Nomura, Takeshi. (Oak Ridge Y-12 Plant, TN (USA)). [1986]. Contract AC05-84OS21400. Translation of Japanese Patent Application No. 1983-58,227,626. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86011152.

This invention relates to the thermopervaporation system. Thermopervaporation has been generally known as a method of conducting a separate condensation of a liquid, in which the raw liquid or hot liquid to be processed, for example, hot sea water is allowed to pass through the primary side of a porous polymeric membrane that permits liquid vapor to permeate but does not allow the liquid itself to permeate, and to condense the vapor which was produced from the raw liquid and passed through the above-mentioned porous membrane in the secondary side by cooling, and thus, in this manner the raw liquid is condensed in the primary side and the condensed water is collected in the secondary side. Various systems have been also proposed in the past for such purposes. The purpose here is to offer a tube-type thermopervaporation system which has a greater effective membrane area per unit volume and offers an excellent process efficiency. 3 figs.

34405 (Y/TR—86/4) Thermopervaporation device. Kimura, Takashi; Nomura, Takeshi; Shimatani, Shunichi; Yoshimura, Atsunari. (Oak Ridge Y-12 Plant, TN (USA); Nitto Electric Industrial Co. Ltd., Ibaraki, Osaka (Japan)). [1986]. Contract AC05-84OS21400. Translation of Japanese Patent Application No. 58-227627, June 25, 1985. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86011151.

It consists of (1) a shell and (2) one or more tubular membranes, which are made of polymerporous membranes, which allow liquid vapor to permeate, but does not allow the liquid itself to permeate, and which are contained in the above-mentioned shell and form a liquid channel between themselves and the shell. The characteristic feature of the thermopervaporation apparatus is that it allows high-temperature liquid to flow through the above tubular membrane of the liquid channel, while low-temperature liquid passes through the other, then the vapor which is produced from the high-temperature liquid and permeates the tubular membrane will be cooled and condensed by the low-temperature liquid and then will be collected in the low-temperature liquid.

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REFER ALSO TO CITATION(S) 34290, 34405, 34446, 34459, 34496

34406 (INIS-mf—10105) 7th Czechoslovak spectroscopic conference and VIIIth CANAS (Conference on analytical atomic spectroscopy). Abstracts. Vol. 2. Section M (molecular spectroscopy). (Ceskoslovenska Spektroskopicka Spolecnost, Prague). 1984. 16p. (CONF-8406249—Vol.2-Absts.). NTIS (US Sales Only), PC A02/MF A01. File Number DE86702155.

From 7. Czechoslovak spectroscopic conference and 8. CANAS; Ceske Budejovice, Czechoslovkia (18 Jun 1984).

The conference on spectroscopy held in Ceske Budejovice on June 18-22, 1984, proceeded in three sessions: atomic spectroscopy, molecular spectroscopy and special spectroscopic techniques. In the molecular spectroscopy session, 81 papers were read of which 12 were inputted in INIS. The subject of inputted papers was the use of NMR for the analysis of organic compounds and for the study of radiation defects in semiconductors, and the use of infrared spectroscopy for the analysis of nuclear and irradiated materials.

34407 (INIS-mf—10105, pp 7) NMR bandshape analysis of multisite exchange systems. Sandstroem, J. (Lund Univ., Sweden). 1984. NTIS (US Sales Only), PC A02/MF A01. File Number DE86702155. (CONF-8406249—Vol.2-Absts.).

From 7. Czechoslovak spectroscopic conference and 8. CANAS; Ceske Budejovice, Czechoslovkia (18 Jun 1984).

34408 (INIS-mf—10105, pp 99) Sodium-23 NMR study of alkali ion-crown ether complexes. Zajicek, J.; Zavada, J.; Stibor, I.; Pechanec, V. (Ceskoslovenska Akademie Ved, Prague. Ustav Organicke Chemie a Biochemie). 1984. NTIS (US Sales Only), PC A02/MF A01. File Number DE86702155. (CONF-8406249—Vol.2-Absts.).

From 7. Czechoslovak spectroscopic conference and 8. CANAS; Ceske Budejovice, Czechoslovkia (18 Jun 1984).

34409 (Y/DK—472) Determination of fluoborate in fluoborate acid and lead plating solutions using a specific fluoborate ion electrode. Cole, T.W.; Green, L.A. (Oak Ridge Y-12 Plant, TN (USA)). 30 Apr 1986. Contract AC05-84OS21400. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86010865.

The fluoborate ion (BF^-_4) in lead plating solutions and in fluoboric acids (HBF_4) is measured quickly, simply, and accurately with the specific BF^-_4 electrode in conjunction with a double-junction reference electrode. As there is very little preparation to be done to the samples, at least eight samples can be analyzed in an 8-h shift. Results are given that show the change in the BF^-_4 content at different time intervals and the relative limit of error of each set of analyses. 1 refs., 2 tabs.

34410 Natural bond orbital analysis of molecular interactions: Theoretical studies of binary complexes of HF, H_2O, NH_3, N_2, O_2, F_2, CO, and CO_2 with HF, H_2O, and NH_3. Reed, A.E.; Weinhold, F.; Curtiss, L.A.; Pochatko, D.J. (Theoretical Chemistry Institute and Deparment of Chemistry, University of Wisconsin, Madison, Wisconsin 53706). *Journal of Chemical Physics;* **84**: No. 10, 5687-5705(15 May 1986). Contract W-31-109-ENG-38.

The binary complexes of HF, H_2O, NH_3, N_2, O_2, F_2, CO, and CO_2 with HF, H_2O, and NH_3 have been studied by ab initio molecular orbital theory and natural bond orbital (NBO) analysis. Most of the complexes involving N_2, O_2, F_2, CO, and CO_2 are found to have both hydrogen-bonded and non-hydrogen-bonded structures. The NBO analysis provides a consistent picture of the bonding in this entire family of complexes in terms of charge transfer (CT) interactions, showing the close correlation of these interactions with the van der Waals penetration distance and dissociation energy of the complex. Contrary to previous studies based on the Kitaura—Morokuma analysis, we find a clear theoretical distinction between H-bonded and non-H-bonded complexes based on the strength of CT interactions. Charge transfer is generally stronger in H-bonded than in non-H-bonded complexes. It plays an intermediate role in non-H-bonded CO_2 complexes which have been studied experimentally. However, the internal rotation barrier (1 kcal mol^{-1}) of the $H_2OxxxCO_2$ complex is found to be primarily of electrostatic origin with only a small (π-type) CT contribution. The role of electrostatic interactions, effect of electron correlation, and comparison of theory with experiment are also discussed.

34411 Reaction rates for thermal chlorine atoms with H_2S from 232 to 359 K by a radiochemical technique. Lu, E.C.C.; Iyer, R.S.; Rowland, F.S. (Univ. of California, Irvine). *Journal of Physical Chemistry;* **90**: No. 10, 1988-1990(8 May 1986).

The relative rate constants for the gas-phase reactions of thermal chlorine atoms have been measured with H_2S, C_2H_6, and CH_2 = CHBr over the temperature range from 232 to 359 K by using radioactive ^{38}Cl atoms. These data at a pressure of 4000 Torr of $CClF_3$ are consistent with a temperature-dependent rate constant

of (10.5 +/- 0.4) x 10^{-11} cm^3 $molecule^{-1}$ s^{-1}, based on the consensus literature values for the reaction of Cl with C_2H_6. 15 references, 1 figure, 2 tables.

34412 Theoretical study of the isovalent diatomics C_2, Si_2, and SiC. Rohlfing, C.M.; Martin, R.L. (Los Alamos National Lab., NM). *Journal of Physical Chemistry;* **90**: No. 10, 2043-2046(8 May 1986).

Ab initio calculations on the molecules C_2, Si_2, and SiC are performed to determine equilibrium geometries (R/sub e/) and spectroscopic constants (omega/sub e/, omega/sub e/chi/sub e/, and D/sub e/) for various electronic states. A large basis set including two d functions on each atom is used and electron correlation is treated by two different methods. The first approach is that of Moeller-Plesset perturbation theory based on a UHF reference function. The second approach is that of externally contracted configuration interaction based on a multireference function of the complete-active-space type. Good agreement between theory and experiment is achieved for the homonuclear diatomics. The best theoretical value obtained for the ground-state harmonic frequency omega/sub e/ of SiC is 940 cm^{-1}. After consideration of the remaining basis set and correlation effects, an estimate of 975 +/- 10 cm^{-1} is made for omega/sub e/ in the unobserved molecule SiC. Finally, a comparison is made between the two theoretical approaches used in this study. 22 references, 3 tables.

34413 Substitution and fragmentation reactions of $Br_2Os_3(CO)_{12}$ with phosphines. Structure of $Br_2Os_3(CO)_{10}[P(OMe)_3]_2$. Chen, Y.S.; Wang, S.L.; Jacobson, R.A.; Angelici, R.J. (Iowa State Univ., Ames). *Inorganic Chemistry;* **25**: No. 8, 1118-1122(9 Apr 1986). Contract W-7405-ENG-82.

At room temperature the linear complex $Br_2Os_3(CO)_{12}$ reacts with PPh_3 and PPh_2Me to give the substituted product $Br_2Os_3(CO)_{10}(PR_3)_2$ (~ 15%), as well as the mononuclear products $Os(CO)_4PR_3$ (~ 60%) and $Br_2Os(CO)_3(PR_3)_2$ (~ 15%). The mononuclear products are not formed from $Br_2Os_3(CO)_{10}(PR_3)_2$ under the conditions of the reaction. The reaction is completely stopped by added CCl_4 or galvinoxyl, suggesting that the formation of both the trinuclear and mononuclear products are radical processes. From the reaction of $Br_2Os_3(CO)_{12}$ with $P(OMe)_3$, the trinuclear complex $Br_2Os_3(CO)_{10}[P(OMe)_3]_2$ is isolated in 53% yield. This complex crystallizes in the centrosymmetric triclinic space group P1 with a = 8.923 (3) A, b = 11.657 (3) A, c = 8.185 (3) A, α = 99.48 (3)°, β = 111.91 (3)°, γ = 96.28 (3)°, and Z = 1.

34414 Characterization, structure, and conformations of a dinuclear platinum(I) complex with mixed halide-phosphine ligands trans to the metal-metal bond. Blau, R.J.; Espenson, J.H.; Kim, S.; Jacobson, R.A. (Iowa State Univ., Ames). *Inorganic Chemistry;* **25**: No. 6, 757-763(12 Mar 1986). Contract W-7405-ENG-82.

The X-ray crystal structure of $[Pt_2(\mu\text{-dppm})_2Cl(PPh_3)]^+(PF_6^-)$ indicates considerable tetrahedral distortion of the normally square-planar environment around its PPh_3-ligated platinum. These distortions relieve repulsions between phenyl groups on PPh_3 and those on the adjacent dppm ligand but cause a significant retardation of the rates of axial/equatorial interchange of substituents on the $Pt_2(\mu\text{-dppm})_2$ ring as observed by ^1H NMR spectroscopy. The ^{31}P NMR spectra of this and related complexes are also consistent with these data.

34415 Absolute stabilization energies for molybdenum 4d electrons based on the reference compound tetrakis(dimethylamido)molybdenum(IV). Beach, D.B.; Jolly, W.L. (Univ. of California, Berkeley). *Inorganic Chemistry;* **25**: No. 6, 875-876(12 Mar 1986). Contract AC03-76SF00098.

The Mo d/sup 5/2/, N 1s and C 1s binding energies of $Mo[N(CH_3)_2]_4$ have been determined in the vapor phase. The Mo 3d/sub 5/2/ binding energy can then be used in conjunction with the ionization potential of other Mo compounds to quantify the bonding characters of molecular orbitals derived from the molybdenum 4d orbitals in these compounds. The relevant data for a number of Mo compounds are summarized in tabular form. 14 references, 1 table.

34416 Next generation of (polyazine)ruthenium(II) complexes. Brewer, K.J.; Murphy, W.R. Jr.; Spurlin, S.R.; Petersen, J.D. (Clemson Univ., SC). *Inorganic Chemistry;* **25**: No. 6, 882-884(12 Mar 1986).

The synthesis and characterization of a new, highly luminescent complex of ruthenium and 2,3-bis(2-pyridyl)pyrazine (dpp) of the type $Ru(dpp)_3^{2+}$ are reported. Comparison of the intensity of the electronic absorption and emission spectra of this complex with that of $Ru(bpy)_3^{2+}$ where bpy = 2,2'-bipyridine, the complex so often used to study capture, storage, and utilization of solar energy, suggests that the complexes have similar luminescence quantum yields. The presence of three bidentate remote binding sites in $Ru(dpp)_3^{2+}$ raises the possibility of preparing polymetallic clusters with appreciable excited-state lifetimes to generate systems capable of photocatalyzing multielectron reactions. 23 references, 2 figures.

34417 Synthesis, electrical properties, and crystal structure of the first organic metal-solid electrolyte hybrid: (BEDT-TTF)$_3$Ag/sub x/I_8 (x ~ 6.4). Geiser, U.; Wang, H.H.; Donega, K.M.; Anderson, B.A.; Williams, J.M.; Kwak, J.F. (Argonne National Lab., IL). *Inorganic Chemistry;* **25**: No. 4, 401-402(12 Feb 1986). Contract W-31-109-ENG-38.

The preparation, crystal structure, and the electrical properties of the compound $(ET)_3Ag/sub\ x/I_8$ where x = approx. 6.4 and ET is bis(ethylenedithio)tetrathiafulvalene, $C_{10}S_8H_8$, are described. The compound possesses a truly two-dimensional polymeric anion, one which combines the structural features of both an organic electronic conductor and an inorganic solid electrolyte. The crystal structure consists of alternating anion and cation donor layers. The compound exhibits high electronic conductivity dominated by the electronic contribution, at least near room temperature.

34418 Potential dependence of the stretching frequency of carbon monoxide bound to the surface of platinum dispersed in an electrode-confined redox polymer. Andre, J.F.; Wrighton, M.S. (Massachusetts Institute of Technology, Cambridge). *Inorganic Chemistry;* **25**: No. 4, 532-535(12 Feb 1986).

Variation in the electrochemical potential of the electrode results in a change in the stretching frequency of CO bound to elemental Pt dispersed in an electrode-confined redox polymer, (PQ/sup 2+/+/)/sub n/, derived from an N,N'-dialkyl-4,4'-bipyridinium monomer. The stretching frequency of the CO, about 2000 cm^{-1}, can be monitored by transmission infrared spectroscopy using a Fourier transform infrared (FTIR) spectrometer and moves to lower values with movement of the potential to more negative values. Spectroelectrochemical studies were conducted by using an IR-transparent n-Si/[(PQ/sup 2+/+/Pt(CO)/sub x/)/sub n/] electrode assembly in an electrochemical cell with the derivatized surface exposed to the electrolyte solution. Experiments have been carried out with both natural-abundance and 99% ^{13}C-enriched CO, and the potential dependence is the same, about 20 cm^{-1} V^{-1}, over the potential range studied, approximately 0.0 to -1.4 V vs. Ag^+/Ag in CH_3CN/2 M $LiClO_4$. The stretching frequency of natural-abundance CO in the same assembly has been studied in H_2O/3 M LiCl and shows a slightly larger potential dependence, about 35 cm^{-1} V^{-1}, in the range -0.2 to -1.0 V vs. AgCl/Ag. The data for the CO bound to the Pt dispersed in the polymer is in accord with similar data obtained for CO bound to smooth Pt electrode surfaces.

34419 Complexes of rare-earth elements with 1,3-diamino-2-hydroxypropane-N,N,N',N'-tetraacetic acid. Powell, J.E.; Ling, D.R.; Tse, P.K. (Iowa State Univ., Ames). *Inorganic Chemistry;* **25**: No. 4, 585-586(12 Feb 1986).

Complexes of the rare earth elements with 1,3-diamino-2-hydroxypropane-N,N,N'N'-tetraacetic acid (DHPTA) were prepared, and their stability constants were determined and compared with those of complexes with trimethylenediamine-N,-N,N'N'-tetraacetate (TMDTA), (bis(2-aminoethyl)ether)-N,N,N',N'-tetraacetate (EEDTA), (bis(3-aminopropyl)ether)-N,N,N',N'-tetraacetate (BPETA), and ethylenediamine tetraacetate (EDTA). The stability constants of the complexes of DHPTA and TMDTA are on the order of 10,000-fold less than those of EDTA. An analogous effect

was seen in comparison to the stability of complexes of EEDTA and BPETA. Explanations are advanced for these noted differences in stability constants. Separation factors for adjacent lanthanides calculated from stability constant ratios of the DHPTA complexes are tabulated. It is concluded that DHPTA might prove useful for separation of most lanthanides from each other, but not the Eu-Gd pair and probably not the Dy-Ho pair. Separation factors are compared for the different complexes and possible separations predicted are Pm from nuclear wastes using DHPTA and Dy-Y separation using DHPTA. 14 references, 1 figure, 2 tables.

34420 **Effect of changes in the ligand's backbone moiety on formation constants of 1:1 nickel, copper, zinc, and cadmium chelates.** Powell, J.E.; Ling, D.R.; Tse, P.K. (Iowa State Univ., Ames). *Inorganic Chemistry;* **25**: No. 4, 587-588(12 Feb 1986).

The affinities of two ligands, (bis(2-aminoethyl)ether)-N,N,N'N'-tetraacetate (EEDTA) and (bis(3-aminopropyl)ether)-N,N,N'N'-tetraacetate (DEATA) for the divalent transition-metal ions, Ni^{+2}, Cu^{+2}, Zn^{+2}, and Cd^{+2} are reported. Formation constants for complexes of Ni, Cu, Zn, Cd, and lanthanides with diamino tetraacetate ligands having a variety of backbones are compared in order to demonstrate the effect that cation size has as the number of members in potential chelate rings is varied. 10 references, 1 figure, 2 tables.

34421 **Production of gallium atoms by excimer laser photolysis of trimethylgallium.** Baughcum, S.L.; Oldenborg, R.C.; Winn, K.R.; Hof, D.E. (Los Alamos National Lab., NM). *Proceedings of the Society of Photo-Optical Instrumentation Engineers;* **540**: 314-321(1985).

From Southwest conference on optics; Albuquerque, NM, USA (4-8 Mar 1985).

The gas phase kinetics of group III elements such as gallium are important in potential chemically-driven energy-transfer lasers and in chemical vapor deposition processes in the electronics industry. Excimer laser photodissociation of volatile gallium compounds via multiple-photon processes provides, in principle, a convenient room-temperature source of gallium atoms for study using laser photolysis/laser-induced fluorescence techniques. In this paper, preliminary results on the production of atomic gallium from the multiple-photon dissociation of trimethylgallium at 193 nm is reported. Prompt emission from a number of excited gallium states (5 ^{2}S, 4 ^{2}D, 6 ^{2}S, 6 ^{3}P°, 5 ^{3}D, and 4 ^{4}P) is observed. The time histories of the ground state (4 ^{2}P/sub 1/2/°) and the metastable state (4 ^{2}P/sub 3/2/°) have been measured using laser-induced fluorescence. The resulting time profiles are complicated even in the absence of an added reactant gas by the apparent production of ground state gallium at relatively long times ($\sim$ 10 μs) after the excimer laser pulse. Possible mechanisms for this (i.e., radical reactions to produce gallium, energy transfer, cascading from high lying metastable states, ionic processes, etc.) are being investigated. These results indicate that the photodissociation of trimethylgallium at 193 nm is complex. Mechanistic considerations suggest that photolysis at other wavelengths and with other precursors may lead to a cleaner source of gas-phase atomic gallium for kinetic studies, and these studies are in progress. 20 references, 7 figures.

34422 **p-V-T relations for liquids and liquid mixtures: the choice of a reference state.** Brostow, W.; Macip, M.A.; Ruether, J.A. (Drexel Univ., Philadelphia, PA). pp 114 of IUPAC conference on chemical thermodynamics. Hamilton, Ontario; McMaster University (1984). (CONF-840807—).

From Conference on chemical thermodynamics and 39. calorimetry conference; Hamilton, Canada (13 Aug 1984).

Volumes, V, of liquids and liquid mixtures as a function of temperature, T, and pressure, p, are often calculated from relations involving reduced quantities. This is the case of the Guggenheim equation for V(Ar) applied to other liquids and liquid mixtures and subsequently referred to as the Guggenheim-Lu-Ruether equation (G-L-R). However, for G-L-R, as well as for many other reduced p-V-T relations, the reference state is the liquid-vapor critical point (CP). For many liquids, coal conversion products in particular, parameters at CP are not accessible experimentally, while extrapolation procedures are doubtful. Moreover, CPs do not exist for liquid polymers. Under the circumstances, alternative reference states have been studied for the G-L-R equation. It is demonstrated that reducing parameters other than those at CP can be used, and in fact lead to very good agreement between calculated and experimental values.

34423 **Enthalpies of dilution of aqueous calcium chloride and hydrochloric acid at high temperatures. Implications for modeling.** Simonson, J.M.; Busey, R.H.; Archer, D.G.; Mesmer, R.E. (Oak Ridge National Lab., TN). pp 74 of IUPAC conference on chemical thermodynamics. Hamilton, Ontario; McMaster University (1984). (CONF-840807—). Contract W-7405-ENG-26.

From Conference on chemical thermodynamics and 39. calorimetry conference; Hamilton, Canada (13 Aug 1984).

Enthalpies of dilution have recently been measured for HCl(aq) and $CaCl_2$(aq) using a heat- and liquid-flow microcalorimeter. The dilution results range from 0.01 to 15.6 mol x kg^{-1} HCl at temperatures from 298.15 K to 648 K; the $CaCl_2$(aq) study includes results from 0.002 to 7.2 mol x kg^{-1} $CaCl_2$ at temperatures from 298.15 k to 673 K. In dilute solutions above 523 K, the measured enthalpies of dilution for these two systems are more exothermic than those calculated from the Debye-Hueckel limiting law. At lower temperatures, enthalpies of dilution less exothermic than predicted by the limiting law, the more usual case, are observed. In concentrated solutions below 473 K the measured enthalpies of dilution are much larger than would be expected from extrapolation of results for NaCl(aq) to higher ionic strengths. The limitations on the use of the ion interaction model in representing these results are discussed. Also discussed are the effects on the observed thermodynamic properties of ion association and hydration in these solutions.

34424 **Thermodynamics of aqueous solutions of the alkali metal sulfates to 498 K.** Holmes, H.F.; Mesmer, R.E. (Oak Ridge National Lab., TN). pp 83 of IUPAC conference on chemical thermodynamics. Hamilton, Ontario; McMaster University (1984). (CONF-840807—). Contract W-7405-ENG-26.

From Conference on chemical thermodynamics and 39. calorimetry conference; Hamilton, Canada (13 Aug 1984).

Isopiestic ratios, relative to NaCl(aq) which allows one to calculate osmotic coefficients, have been measured for aqueous solutions of the alkali metal sulfates over the temperature range 383 to 498 K and to saturation molalities (except to about 6 mol x kg^{-1} for Cs_2SO_4 which is more soluble). The results have been analyzed within the framework of the ion interaction model. Osmotic and activity coefficients show a monotonic decrease with increasing temperature in this temperature range. Present results are consistent with most of the previous thermodynamic data for the systems as the existing experimental results (various types, including enthalpies and heat capacities) have been combined to derive a mathematical model giving the excess thermodynamic quantities as a function of temperature and molality.

34425 **Second ionization of carbonic acid in NaCl media to 523 K.** Patterson, C.S.; Busey, R.H.; Mesmer, R.E. (Oak Ridge National Lab., TN). pp 84 of IUPAC conference on chemical thermodynamics. Hamilton, Ontario; McMaster University (1984). (CONF-840807—). Contract W-7405-ENG-26.

From Conference on chemical thermodynamics and 39. calorimetry conference; Hamilton, Canada (13 Aug 1984).

New experimental results from a potentiometric study at Oak Ridge National Laboratory of the second ionization quotient of carbonic acid will be reported. Results were obtained in NaCl media from 0.2 to 5 mol x dm^{-3} NaCl and from 323 to 523 K. The new results have been combined with other selected information in the literature to arrive at a model from which to derive the thermodynamic parameters for the process from infinite dilution to 5 mol d dm^{-3}. Approximate values for the pressure coefficient were also obtained enabling interpolations to be made to the saturation vapor pressure of water. These new results demonstrate that $\log_{10} K_2$/K/sub w/ against 1/T gives a nearly straight line dependence as was observed in a number of other cases in this program. This provides the best means of extrapolation beyond the temperature of the measurements. The values of K_2 at high temperatures are considerably larger than those previously reported. These results have been applied to an examination of the solubility of calcite as a function of

pH for the condition where the calcium ion concentration equals the carbonate concentration in all forms. The results are discussed and compared with the other ionization processes for which precise values are available.

34426 **Thermodynamics of aqueous $MgSO_4$ and Na_2SO_4.** Phutela, R.C.; Pitzer, K.S. (Lawrence Berkeley Laboratory, CA). pp 87-88 of IUPAC conference on chemical thermodynamics. Hamilton, Ontario; McMaster University (1984). (CONF-840807—).

From Conference on chemical thermodynamics and 39. calorimetry conference; Hamilton, Canada (13 Aug 1984).

A volumetric and calorimetric study of the aqueous solutions of sodium sulfate and magnesium sulfate have been carried out using a densimeter and a micro flow calorimeter, both of which have been built in our laboratory. Densities of aqueous sodium sulfate and aqueous magnesium sulfate have been measured up to 473 K and 100 bar. Heat capacities of aqueous magnesium sulfate were measured at 20 bar and up to 573 K. The results have been analyzed using Pitzer equations. The relationships to other geochemically important fluids are discussed.

34427 **Hydrolysis of iodine: equilibria at high temperatures.** Palmer, D.A.; Ramette, R.W.; Mesmer, R.E. (Oak Ridge National Lab., TN). pp 93 of IUPAC conference on chemical thermodynamics. Hamilton, Ontario; McMaster University (1984). (CONF-840807—). Contract W-7405-ENG-26.

From Conference on chemical thermodynamics and 39. calorimetry conference; Hamilton, Canada (13 Aug 1984).

In any model of the behavior of molecular iodine in aqueous solution, the reaction of principal concern is the disproportionation process described by equation (1). The equilibrium constant for this reaction was determined $3I_2 + 3H_2O = IO_3^- + 5I^- + 6H^+$ from e.m.f. measurements over the temperature range 276.95 to 482 K. The values of the equilibrium constant and associated thermodynamic parameters at 298.15 K are: $K_1 = 1.13 \times 10^{-47}$, Δ H/sub m/° = (265 +/- 7) kJ x mol^{-1}, Δ S/sub m/° = -9 J x K^{-1} x mol^{-1}, and Δ C/sub p/°,m = -(1378 +/- 46) J x K^{-1} mol^{-1}. Two other reactions pertinent to equation (1) were also studied. Firstly, the formation of the triiodide ion, equation (2), $I_2 + I^- = I_3^-$ was studied by an iodine vapor distribution method over the same temperature range. The following parameters best describe the results at 298.15 K: $K_2 = 698$, Δ H/sub m/° = -17.0 kJ x mol^{-1}, Δ S/sub m/° = -2.5 J x K^{-1} x mol^{-1}, and Δ C/sub p/°,m = -21 J x K^{-1} x mol^{-1}. Secondly, the acid dissociation constant for iodic acid was measured from $TlIO_3$ solubilities over the temperature range 275.35 to 348 K. From the known K/sub a/ value at 298.15 K, 0.157, a temperature-independent Δ H/sub m/° of -(8.2 +/- 0.4) kJ x mol^{-1} was obtained and a Δ S/sub m/° value of -(43 +/- 3) J x K^{-1} x mol^{-1}. These results are used to update an existing computer model of iodine hydrolysis behavior under conditions appropriate to nuclear accident scenarios.

34428 **Calorimetry, metal hydrides, and the calorimetry conference.** Flotow, H.E. (Argonne National Lab., IL). pp 231 of IUPAC conference on chemical thermodynamics. Hamilton, Ontario; McMaster University (1984). (CONF-840807—).

From Conference on chemical thermodynamics and 39. calorimetry conference; Hamilton, Canada (13 Aug 1984).

Most of this lecture is devoted to showing, by various examples, how calorimetry and thermodynamics applied to metal hydride systems leads to a productive interaction between theory and experimental results. Metal hydrides will find a significant role in high-technology applications before the end of this century.

34429 **Electronic structure near metal-metal interfaces.** Davenport, J.W.; Weinert, M. (Brookhaven National Lab., Upton, NY). *Surface Science;* **144**: 220-223(1984). Contract AC02-76CH00016.

A review is given of recent calculations on metal films which give information about metal-metal interfaces. The systems discussed will include palladium on niobium, cesium on tungsten, and nickel on copper. In general it is found that the electronic structure closely resembles the bulk within one or two atomic layers of the interface. Using these methods it is possible to calculate directly the interface energy. 11 references.

34430 **Surface chemistry of the thermal cracking of silane on silicon (111).** Farnaam, M.K.; Olander, D.R. (Univ. of California, Berkeley). *Surface Science;* **145**: 390-406(1984). Contract AC03-76SF00098.

The kinetics of the thermal decomposition of silane gas during epitaxial growth on the (111) face of single crystal silicon were studied by modulated molecular beam mass spectrometry over the temperature range of 1000-1440 K and with beam intensities from 2×20^{16} to 2×10^{16} molecules/cm^2 x s. An abrupt change in the apparent reaction probability was observed at ~ 1130 K, coinciding with a known surface structural transformation at about the same temperature. The molecular beam data for temperatures higher than 1130 K were used for construction of a reaction model. Additional experiments were conducted to fix certain features of the reaction mechanism. An attempt was made to measure the rate constant for desorption of unreacted silane molecules from the surface. The residence time of silane on the surface was below the sensitivity limit of the technique (< 5 μs), which means that SiH_4 desorption is not rate-limiting. Applications of a simultaneous modulated beam of SiH_4 and a steady beam of SiD_4 did not produce HD molecules, thus ruling out hydrogen atom production in the surface reaction mechanism. According to the proposed model, silane molecules which do not reflect from the surface undergo a branched reaction with two types of sites on the surface, producing two bound SiH_2 molecules in each chemisorption event. Subsequent surface decomposition of the adsorbed SiH_2 molecules occur with different pre-exponential factors, although with similar activation energies of about 17 kcal/mol for the two types of sites. 29 references, 7 figures.

34431 **Doppler-free two-photon spectroscopy of the 2 nu_3 band of SF_6.** Patterson, C.W.; Herlemont, F.; Azizi, M.; Lemaire, J. (Los Alamos National Lab., NM). *Journal of Molecular Spectroscopy;* **108**: 31-41(1984).

The assignments of most of the observed Doppler-free two-photon spectra of the 2 nu_3 band of SF_6 near the P(14)-P(20) lines of a 10-μm CO_2 waveguide laser are reported. The rovibrational and anharmonic constants for this band were obtained, along with ground state constants determined from observed forbidden transitions. 20 references, 4 figures, 2 tables.

34432 **Rh on TiO_2: model catalyst studies of the strong metal-support interaction.** Sadeghi, H.R.; Henrich, V.E. (Yale Univ., New Haven, CT). *Applications of Surface Science;* **19**: 330-340(1984). Contract AC02-81ER10830.

Investigations of the strong metal-support interaction (SMSI) are simplified by the use of model catalysts in which the metal particles are supported on stable, well characterized single-crystal substrates. The authors have used surface-sensitive electron spectroscopies, CO chemisorption measurements and Auger sputter profiling to study Rh/TiO_2 (110) model catalysts. The dynamics of oxidation of reduced TiO_2 surfaces have been investigated as a function of annealing temperature. High temperature reduction of Rh/TiO_2 (110) catalysts to an SMSI state is accompanied by the formation of a suboxide of Ti on the Rh particles, thus blocking CO chemisorption sites. 24 references, 6 figures.

34433 **Hyperfine structure of alkaline-earth monohalide radicals: new methods and new results 1980-1982.** Childs, W.J. (Argonne National Lab., IL). *Comments on Atomic and Molecular Physics;* **13**: No. 1, 37-50(1983). Contract W-31-109-ENG-38.

The first observation of the hyperfine structure of a fully isolated alkaline-earth monohalide radical was published in 1980. This review summarizes the various approaches used since then, and outlines the present status of our knowledge. Particular attention is given to the contributions of the molecular-beam, laser-rf, double-resonance technique. Sophisticated ab initio calculations are needed for comparison with the large body of high quality data now at hand. 24 references, 5 figures, 3 tables.

34434 Collisional energy transfer in tin by diatomics and inert gases. Gelbwachs, J.A.; Nesbitt, R.S.; Frueholz, R.P. (Aerospace Corp., Los Angeles, CA). *Chemical Physics Letters;* 77: No. 1, 222-227(1 Jan 1981).

Collisional energy transfer between laser-excited atomic tin and both inert-gas and diatomic collision partners has been studied. Relative populations of collisionally populated tin levels were determined. For certain levels, diatomics transferred nearly two orders of magnitude more population than inert gases; for other levels, there was nearly equal population transfer by both groups of partners. 23 references, 4 figures.

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REFER ALSO TO CITATION(S) 33538, 33543, 33546, 34406, 34407, 34408, 34413, 34414, 34415, 34416, 34417, 34419, 34420, 34421, 34422, 34459

34435 (DOE/ER/05006—T3) Carbon-13 NMR of solid state hydrocarbons and related substances. Final report, March 1, 1978-April 30, 1986. Grant, D.M.; Pugmire, R.J. (Utah Univ., Salt Lake City (USA)). 13 May 1986. Contract AC02-78ER05006. 12p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86010898.

This program, which has been in place at the University of Utah since March 1, 1978, has evolved through several phases. The investigators present a brief overview of past work. Over the period of this grant their efforts have simultaneously focused on a number of parallel developments and projects. This has allowed individual students and researchers in the group to pursue relatively independent goals and objectives while the overall effort continues to exhibit a cohesive theme of NMR in the area of energy related sciences. The following projects are briefly described: (1) spin-relaxation in polycyclic aromatic hydrocarbons; (2) chemical shifts and conformational structure in the hydroaromatics; (3) solid state NMR applications; (4) new methods for enhancing spectral responses in solids; (5) single crystal developments; and (6) NMR of inclusion complexes in the solid state. 28 refs.

34436 (DOE/ER/13430—1) Reductive coupling of carbon monoxide to C_2 products. (North Carolina Univ., Chapel Hill (USA)). 1986. Contract FG05-85ER13430. 3p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86011298.

During the past eight months we have initiated work in the area of reductive coupling of carbon monoxide based on strategies set forth in our proposal. Progress to date is summarized in the paragraphs below; details of the work will be provided in manuscripts as they are prepared for journal publication. 3 refs.

34437 (INIS-mf—10105, pp 8-9) **Conformational structure of poly(methyl methacrylate) and of its model compounds.** Schneider, B.; Dybal, J.; Stokr, J.; Doskocilova, D.; Spevacek, J. (Ceskoslovenska Akademie Ved, Prague. Ustav Makromolekularni Chemie). 1984. NTIS (US Sales Only), PC A02/MF A01. File Number DE86702155. (CONF-8406249—Vol.2-Absts.).

From 7. Czechoslovak spectroscopic conference and 8. CANAS; Ceske Budejovice, Czechoslovkia (18 Jun 1984).

34438 (INIS-mf—10105, pp 82) **Sequence analysis of propylene oxide-ethylene oxide polyether polyols by carbon-13 nuclear magnetic resonance.** Halmo, F.; Liptaj, T.; Malik, L.; Palovcik, R. (Research Institute for Petrochemistry, Novaky, Czechoslovakia; Slovenska Vysoka Skola Technicka, Bratislava, Czechoslovakia. Chemickotechnologicka Fakulta). 1984. NTIS (US Sales Only), PC A02/MF A01. File Number DE86702155. (CONF-8406249—Vol.2-Absts.).

From 7. Czechoslovak spectroscopic conference and 8. CANAS; Ceske Budejovice, Czechoslovkia (18 Jun 1984).

34439 (INIS-mf—10105, pp 89) **^{1}H-NMR analysis of reaction mixture of lauric acid with monoethanolamine utilizing in situ reaction with trichloroacetyl isocyanate.** Nemecek, J.; Ksandr, Z.; Karhan, J.; Budesinsky, M. (Vysoka Skola Chemicko-Technologicka, Prague, Czechoslovakia; Ceskoslovenska Akademie Ved, Prague. Ustav Organicke Chemie a Biochemie). 1984. NTIS (US Sales Only), PC A02/MF A01. File Number DE86702155. (CONF-8406249—Vol.2-Absts.).

From 7. Czechoslovak spectroscopic conference and 8. CANAS; Ceske Budejovice, Czechoslovkia (18 Jun 1984).

34440 (INIS-mf—10105, pp 98) **Complete NMR analysis of the sesquiterpene lactone arctolide.** Saman, D.; Budesinsky, M.; Pelnar, J.; Holub, M. (Ceskoslovenska Akademie Ved, Prague. Ustav Organicke Chemie a Biochemie). 1984. NTIS (US Sales Only), PC A02/MF A01. File Number DE86702155. (CONF-8406249—Vol.2-Absts.).

From 7. Czechoslovak spectroscopic conference and 8. CANAS; Ceske Budejovice, Czechoslovkia (18 Jun 1984).

34441 (SAND—86-0815C) Reactivity of silicates. I. Kinetic studies of the hydrolysis of linear and cyclic siloxanes as models for defect structure in silicates. Balfe, C.A.; Ward, K.J.; Tallant, D.R.; Martinez, S.L. (Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 7p. (CONF-860445—12). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010963.

From Materials Research Society spring meeting; Palo Alto, CA, USA (15 Apr 1986).

The kinetics of hydrolysis of hexamethylcyclotrisiloxane and di-t-butyldmesitylcyclodisiloxane in tetrahydrofuran solution have been determined and compared to hydrolysis rates of silica defects. In the presence of sufficient excess water, the first-order rate constant of the cyclotrisiloxane, $K = 3.8 \times 10^{-3}$ min^{-1}, of the disappearance of the D2 raman silica defect band it has been proposed to model. Limited hydrolysis rate data for the cyclodisiloxane suggest that it hydrolyzes at least four times faster than the cyclotrisiloxane. These data are consistent with rate data available for silica crack growth and supports the assignment of highly strained siloxane bonds at the crack tip to cyclodisiloxanes. Infrared spectra determined for the cyclodisiloxanes lend further support to this model. 41 refs., 3 figs., 1 tab.

34442 (UCID—20047-Rev.1) Sorption detector system for chemical agents detection and recognition. Revision 1. Olness, D.; Hirschfeld, T. (Lawrence Livermore National Lab., CA (USA)). 11 May 1984. Contract W-7405-ENG-48. 71p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86010660.

The use of the piezoelectric sorption sensor, in which an analyte's absorption in a thin surface layer on a piezoelectric vibrator changes its resonant frequency, has been extensively described. In every instance, the chemical selectivity of the device hinges on that of the absorbing layer. In a complex environment, few analytes are so distinctive as to permit this. An alternative approach uses an array of crystals (or of vibrational nodes in a microlithographically cut multivibrator) covered with a number of different absorbing layers. The behavior in Fourier space of these frequency shifts is then used for pattern recognition of individual chemicals. Mixture overlap can then be handled via time derivative measurements, factor analysis, or correlation spectroscopy. Experimental results from this combination of chemometrics and their "Fourier transform mechanical spectroscopy" is given. Experimental results of the demonstrated feasibility of a procedure for providing complete selectivity to quartz piezobalance sensors, by using an array of different sensor layers and pattern recognition, are presented. A laboratory test system, based on this technology, is described. 37 refs., 14 figs., 7 tabs.

34443 Nonphotochemical hole burning of self-aggregated dimers of chlorophyll a in polystyrene. Carter, T.P.; Small, G.J. (Iowa State Univ., Ames). *Journal of Physical Chemistry;* 90: No. 10, 1997-1998(8 May 1986). Contract W-7405-ENG-82.

Nonphotochemical hole burning is reported for several burn frequencies throughout the inhomogeneous profiles of chlorophyll a Q/sub y/(0-0) dimer bands in polystyrene films. The holes burned at T = 1.8 K are stable and show no spontaneous hole filling at short times (~ 1 h). The hole width associated with the lowest dimer component has a value of 0.16 +/- 0.03 cm^{-1} at 1.8 K. 17 references, 1 figure.

34444 Ab initio molecular orbital calculations on isolated vibrational frequencies in AMe_3 radicals and radical ions (A = B^-, C, N^+, Al^-, Si, P^+). Carmichael, I. (Univ. of Notre Dame, IN). *Journal of Physical Chemistry;* **90**: No. 10, 2057-2060(8 May 1986).

A linear correlation is found between ab initio estimates of the C-H bond lengths in AMe_3 radicals and radical ions (A = B^-, C, N^+, Al^-, Si, P^+) and the theoretically derived harmonic frequencies for deuterium-isolated C-H stretches. SCF molecular orbital calculations within the unrestricted Hartree-Fock approximation employing a split-valence basis set coupled with an analytic second-derivative procedure for force constants are used to obtain these frequencies. The calculated data are scaled to experiment by comparison with the well-characterized isolated vibrations in trimethylamine, trimethylphosphine, and trimethylborane. After scaling, relatively accurate predictions are possible for the so far unobserved isolated C-H vibrations in the AMe_3 species listed above. For the substituted tert-butyl radical, absorptions in the vicinity of 2825 and 2905 cm^{-1} are expected. The corresponding pair in the trimethylaluminum molecule should lie around 2890 and 2940 cm^{-1}. For the systems considered, the C-D stretches for monodeuterated radicals and the C-Mu stretches for muonium-containing radicals are also isolated and can be estimated by another simple scaling argument. The preferred site of (formal) muonium replacement has been identified and estimates of the parameters in a simple expression for the dihedral-angle dependence of the proton (or muon) hyperfine splitting constant have been derived. 26 references, 3 figures, 8 tables.

34445 Hydrogen-atom abstraction from alkanes by OH. 3. Propane. Droege, A.T.; Tully, F.P. (Sandia National Labs., Livermore, CA). *Journal of Physical Chemistry;* **90**: No. 9, 1949-1954(24 Apr 1986).

Absolute rate coefficients for the reactions of the hydroxyl radical with six selectively deuterated isotopes of propane were determined by the laser photolysis/laser-induced fluorescence technique. Kinetic data were obtained at 400-Torr helium pressure over the temperature range 293-854 K. Rate-coefficient results for the $OH + C_3H_8 \rightarrow H_2O + C_3H_7$ reaction are fit by the modified Arrhenius expression $k_1(T) = 1.04 \times 10^{-16}$T/sup 1.72/ exp(-288 cal mol^{-1}/RT) cm^3 $molecule^{-1}$ s^{-1}. The reactivity of an individual methyl or methylene group in propane is found to be independent of the hydrogen isotopic content of the remaining alkyl groups in the molecule. Branching ratios for the formation of n-propyl and isopropyl radicals are presented as functions of temperature; abstraction of a secondary hydrogen atom is more important at room temperature and abstraction by OH in propane is characterized. 33 references, 4 figures, 5 tables.

34446 Correlations of ^{195}Pt-^{31}P coupling constants with platinum-ligand and platinum-platinum bond lengths in platinum(I) dimers and in related platinum(II) complexes. Blau, R.J.; Espenson, J.H. (Iowa State Univ., Ames). *Inorganic Chemistry;* **25**: No. 6, 878-880(12 Mar 1986). Contract W-7405-ENG-82.

The availability of dimeric Pt(I) complexes with bridging bis(diphenylphosphino)methane ligands, [L--L']/sup n+/, presents an opportunity to study the physical properties and reactivity of metal-metal bonds as a function of the ligand trans to it with a minimum of competing variables. Several interesting trends of Pt-P coupling constants with the Pt-L and Pt-Pt bond lengths in Pt(I) dimers, [L--L']/sup n+/, and structurally related Pt(II) complexes are reported here. The data indicate that the Pt-P coupling constants continue to be sensitive indicators of not only the structure and stereochemistry of platinum phosphine complexes but also the electronic and steric influences of the ligand in such complexes. 23 references, 1 figure, 4 tables.

34447 Experimental characterization of an electron-rich ($\sigma^2\pi^4\delta^2\delta^{*2}$) metal-metal triple bond. Synthesis, reactivity, and photoelectron spectral studies of trimethylphosphine complexes of dirhenium(II). Root, D.R.; Blevins, C.H.; Lichtenberger, D.L.; Sattelberger, A.P.; Walton, R.A. (Purdue Univ., West Lafayette, IN). *Journal of the American Chemical Society;* **108**: No. 5, 953-959(5 Mar 1986). Contract AC02-80ER10746.

The reaction of $(n\text{-}Bu_4N)_2Re_2X_8$ (X = Cl or Br) with PMe_3 gives high yields of the triply bonded complexes $Re_2X_4(PMe_3)_4$. These compounds are oxidized by $NOPF_6$ to give paramagnetic $(Re_2X_4(PMe_3)_4)PF_6$, and the chloro derivative reacts with $Ph_2PCH_2PPh_2$ (dppm) and $Ph_2PNHPPh_2$ (dppa) to give $Re_2Cl_4(PMe_3)_2$(dppm) and $Re_2Cl_4(PMe_3)_2$(dppa), respectively. NMR spectroscopy (^1H and $^{31}P\{^1H\}$) shows that the latter complexes possess fairly symmetrical structures in which the PMe_3 ligands are in cis dispositions with respect to the bridging dppm and dppa ligands. The volatility of $Re_2Cl_4(PMe_3)_4$ has permitted the measurement of its gas-phase photoelectron spectrum which accords with this compound possessing a $\sigma^2\pi^4\delta^2\delta^{*2}$ configuration. The δ^* ionization band is slightly narrower than the δ ionization band and occurs at about 0.9 eV lower binding energy. The π ionization gives evidence of spin-orbit splitting as expected for the heavy-atom rhenium character. An ionization assigned to removal of an electron from the valence σ orbital is observed at a binding energy 1 eV higher than the π ionization. 42 references, 3 figures, 2 tables.

34448 Single-crystal EXAFS of nitrogenase. Flank, A.M.; Weininger, M.; Mortenson, L.E.; Cramer, S.P. (Exxon Research and Engineering Co., Annandale, NJ). *Journal of the American Chemical Society;* **108**: No. 5, 1049-1055(5 Mar 1986).

Single crystals of the nitrogenase Mo-Fe protein have been examined by polarized x-ray absorption spectroscopy. For different orientations, the Mo-Fe amplitude of the Mo K-edge EXAFS was found to change by a factor of 2.5, whereas the Mo-S component varied by only +- 15%. The orientation dependence of the EXAFS spectra has been used to investigate the geometry and orientation of the Mo, Fe, S clusters within the Mo-Fe protein. This represents the first application of single-crystal EXAFS to an enzyme of unknown crystal structure. 38 references, 10 figures, 3 tables.

34449 Study of the thermochemistry of the $C_2H_5 + O_2 \rightleftharpoons C_2H_5O_2$ and t-$C_4H_9 + O_2 \rightleftharpoons$ t-$C_4H_9O_2$ reactions and of the trend in the alkylperoxy bond strengths. Slagle, I.R.; Ratajczak, E.; Gutman, D. (Illinois Institute of Technology, Chicago). *Journal of Physical Chemistry;* **90**: No. 3, 402-407(30 Jan 1986).

From International conference on chemical kinetics; Gaithersburg, MD, USA (17-19 Jun 1985).

The gas-phase equilibria involving the reactions of ethyl and tert-butyl radicals with molecular oxygen to form the corresponding alkylperoxy radicals have been studied over limited temperature ranges: 336-381°C for the $C_2H_5 + O_2$ system and 277-307°C for the t-$C_4H_9 + O_2$ reaction. The radicals were generated homogeneously in a tubular reactor by the pulsed 248-nm photolysis of C_2H_5Br (C_2H_5) or the 193-nm photolysis of 4,4-dimethyl-1-pentene (t-C_4H_9). The relaxation of the alkyl radical to equilibrium in the presence of O_2 was monitored in real-time experiments using photoionization mass spectrometry. The experiments yielded at least one value of the equilibrium constant at each temperature studied. The enthalpy changes for both $R + O_2 \rightleftharpoons RO_2$ equilibria were obtained by using a third law procedure combining the measured equilibrium constants with calculated or estimated entropy changes for the same reactions. The thermochemical information obtained on these equilibria, combined with that determined earlier for R = CH_3 and i-C_3H_7, indicates that the R-O_2 bond strength ($-\Delta H_{298}°$) increases from 32 to 37 kcal mol^{-1} as the size of the alkyl group increases from CH_3 to t-C_4H_9. 41 references, 2 figures, 3 tables.

34450 Time-resolved resonance Raman spectroscopy of photobiological and photochemical transients. Terner, J.; El-Sayed, M.A. (Virginia Commonwealth Univ., Richmond). *Accounts of Chemical Research;* **18**: No. 11, 331-338(Nov 1985).

Various types of vibrational spectroscopy such as Raman and infrared absorption have long been some of the principal methods for the determination of molecular structures. By monitoring vibrational spectra as a function of time, it is becoming possible to gain a direct picture of the changes that occur during the course of a chemical reaction. The selectivity and enhancement of the resonance Raman effect, and the time-resolution available through the use of laser excitation, have allowed the elucidation of details of photophysical and photochemical processes in complex chemical and biological systems on timescales as short as picoseconds. Future developments in the area of time-resolved resonance Raman spectroscopy will depend upon new innovations in technology as well as the ingenuity of the individual investigators. With the coming improvements in techniques and instrumentation, the contributions of time-resolved resonance Raman spectroscopy to all areas of chemistry should be considerable.

34451 Anomalous electron attachment properties of perfluoropropylene (1-C_3F_6) and their effect on the breakdown strength of this gas. Hunter, S.R.; Christophorou, L.G.; McCorkle, D.L.; Sauers, I.; Ellis, H.W.; James, D.R. (Oak Ridge National Lab., TN). *Journal of Physics, D (London). Applied Physics;* **16**: 573-580(1983). Contract W-7405-ENG-26.

Electron attachment to perfluoropropylene (1-C_3F_6) in 1-C_3F_6/buffer gas mixtures has been found to be anomalously dependent on both the 1-C_3F_6 and buffer gas pressures, as well as on the gas temperature. The authors have found also that the uniform field breakdown strength of pure 1-C_3F_6 is dependent on gas pressure but not on the gas temperature. A mass spectrometer study of the negative ions formed in a moderately high pressure corona discharge has been made, and the principal negative ions formed by electron attachment to 1-C_3F_6 have been identified. Based on these studies, a reaction scheme for electron attachment to 1-C_3F_6 is proposed which results in stable negative ion clusters but does not involve pre-existing dimers. Further, the authors propose that the observed pressure dependence in the breakdown strength of this gas is due to the large pressure dependence of the electron attachment process they observed. 29 references, 3 figures.

34452 (DOE/NBM—6010666) Process and apparatus for the analysis of gases dissolved in nonvolatile liquids. Fleming, J.R. (USDOE Bonneville Power Administration, Portland, OR). [1986]. Translation of Brazilian Patent No. PI 8203039, January 3, 1984. 16p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86010666.

This is a process for the analysis of gases dissolved in nonvolatile liquids, such as the mineral oil used as insulating fluid in transformers, in which there is a total or partial extraction of the bases by exposing, one or more times, the oil to be analyzed to a vacuum. After the extraction, all the extracted gas is injected into a compatible analysis system - for example, chromatographic - capable of analyzing all the gases in only one injection. In this manner, it is possible to obtain directly the absolute proportion of the bases in the analyzed oil without requiring any pressure correction or volume determination. The apparatus, through the use of a modified Toepler pump, allows a total or partial extraction of the dissolved gases in a rapid and efficient manner, and the collection of those gases for further analysis in a compatible system. 1 fig.

4004 Electrochemistry

REFER ALSO TO CITATION(S) 34423, 34427

34453 (DOE/ER/10881—4) Dynamic aspects of the dye-sensitized photoconductivity of semiconductors. Progress report, April 1, 1981-May 31, 1985. Ponte Goncalves, A.M. (Temple Univ., Philadelphia, PA (USA)). May 1986. Contract AC02-81ER10881. 16p. NTIS, PC A02. File Number DE86010892.

The dynamics of the phenomena which determine the efficiency of dye-sensitized semiconductor/electrolyte photoelectrochemical cells were studied. Direct fluorescence lifetime measurements were undertaken to explore the competition between the primary event, injection, and other processes which shorten the lifetime of the dye excited state. Fluorescence quantum yield experiments served to complement the information obtained by direct lifetime measurements. A subnanosecond-resolved transient absorption spectrophotometer was developed for the examination of processes, such as trapping and recombination, which compete with the escape of the injected electron into the bulk of the semiconductor. 6 refs.

34454 Raman scattering study of the staging kinetics in the c-face skin of pyrolytic graphite-H_2SO_4. Eklund, P.C.; Olk, C.H.; Holler, F.J.; Spolar, J.G.; Arakawa, E.G. (Department of Physics and Astronomy, University of Kentucky, Lexington, Kentucky 40506). *Journal of Materials Research;* **1**: No. 2, 361-367(Mar 1986). Contract FG05-84ER45151;AC05-84OR21400.

Raman scattering from the $\sim$1600 cm^{-1} graphitic phonons is used to study the stage evolution of graphite-H_2SO_4 in the first $\sim$1000 A of the bulk during electrochemical intercalation. The Raman results are compared to staging kinetics in the deep bulk studied previously by 001 x-ray diffraction. For low cell currents, which establish quasiequilibrium conditions, the c-face surface of the highly oriented pyrolytic graphite (HOPG) in contact with the reactant rapidly changes stage index to n-1 just as the bulk completes stage n. We conclude that the intercalant must cross the c-face plate boundary of the HOPG, probably entering at either grain boundaries, microcracks, or steps in the plate surface. During stage transitions, the Raman lines are observed to remain Lorentzian in shape, with constant width, indicating that an ordered stage n compound grows at the expense of an ordered stage n-1 compound. In studies of partially submerged HOPG plates, the surface above the acid level is found to stage last, although the plate surface just below the acid level stages first. Lateral diffusion of the sulfate anions from regions below, to regions above the acid level, is apparently impeded for reasons that are not understood. During portions of the electrochemical reaction requiring only hydrogen rearrangement in the intercalate layers ("overcharging"), Raman spectra taken from above and below the acid level are observed to evolve in concert, indicating the protons are not similarly impeded.

34455 E.m.f. measurements on (Li,Al+FeS_2) cells. Tomczuk, Z.; Vissers, D.R. (Argonne National Lab., IL). pp 61-62 of IUPAC conference on chemical thermodynamics. Hamilton, Ontario; McMaster University (1984). (CONF-840807—).

From Conference on chemical thermodynamics and 39. calorimetry conference; Hamilton, Canada (13 Aug 1984).

As the FeS_2 electrode is discharged, the following sulfide phases are formed sequentially: FeS_2, $Li_xFe_2S_4$, Li/sub 2+x/Fe/sub 1-x/S_2($X\approx0.2$) + Fe/sub 1-y/S($y\approx0.1$), Li_2FeS_2, and Li_2S. This paper presents the results of measurements of e.m.f. against T for the first two sequential cell reactions: $2FeS_2 + 3LiAl = Li_xFe_2S_4 + 3Al$, $(1+x-2y)Li_xFe_2S_4 + (1-x-2y-4xy)LiAl = (2-4y)Li$/sub 2+x/Fe/sub 1-x/$S_2 + 4xFe$/sub 1-y/S + (1-x-2y-4xy)Al. The measurements were made with a specially designed FeS_2 electrode which utilized a BN housing and Mo voltage leads. E.m.f. values were obtained from 21 measurements on reaction (1) over the temperature range 655 to 728 K, and from 25 measurements on reaction (2) over the temperature range 663 to 721 K. The results were all for long-term (>1.7 h) measurements at a given temperature.

34456 Electrochemistry of sulfur in halide melts. Selman, J.R.; Saboungi, M.L. (Illinois Institute of Technology, Chicago). pp 81-150 of Sulfur electrode. New York, NY; Academic Press, Inc. (1983). Contract AC02-77ER04445.

The electrochemistry and, more generally, the chemistry of sulfur and sulfides in molten halides offer challenging areas of research from both fundamental and applied points of view. Investigations of the electrochemistry of sulfur and sulfides in alkali halide melts are discussed, with special emphasis on lithium sulfide and the iron sulfides. Sulfur is the leading candidate as the positive electrode material in two kinds of high-temperature batteries, the

sodium-sulfur and the lithium-sulfur batteries. A variety of technical problems with the lithium-sulfur system led to the replacement of elemental sulfur as the positive electrode by metal sulfides such as FeS, FeS_2, Ni_3S_2, and TiS_2, or a mixture of these sulfides. The selection of these active materials for the positive electrode was based on several factors, including their relative insolubility in the electrolytes. The iron sulfides, FeS and FeS_2 appear to be, so far, the most promising candidates for the positive electrode, despite the complexity of their reactions. A review of the state of the art of the chemistry and electrochemistry of FeS and FeS_2 in molten LiCl-KCl solutions is presented even though the FeS electrode cannot be considered a true sulfur electrode. 125 references, 25 figures, 16 tables.

4005 Photochemistry

REFER ALSO TO CITATION(S) 34443, 34453, 34466

34457 (DOE/ER/04908—T1) Laser induced chemical reactions and laser-collision processes. Final technical report, May 1, 1978-April 30, 1986. Light, J.C. (Chicago Univ., IL (USA). James Franck Inst.). May 1986. Contract AC02-78ER04908. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86011459.

Theoretical investigations into the dynamics of atoms and molecules in strong radiation (laser) fields and under electron impact have been carried out. The studies were carried out using quantum mechanics and new approaches were developed for six major areas. First, a new and much more efficient method of solving the time independent quantum scattering equations was developed (VIVAS) and has been disseminated. Second, laser-collision processes were investigated and a negative result was determined - only under very special circumstances and very strong laser fields can the field affect the course of a collision process (versus affecting the states of reactants before collisions). Third, methods for calculating multiphoton absorption by diatomic and polyatomic molecules were developed and applied. Fourth, methods of calculating the final states from single photon photodissociation of triatomic molecules were developed and applied. Analogous methods were developed and applied to electron-molecule collisions which result in either vibrational excitation or dissociative attachment. The first accurate calculations of dissociative-attachment of a triatomic molecule (CO_2) were made. Finally, the distributed Gaussian basis was developed as a general basis for the quantum calculations of vibrational states of polyatomic molecules. 14 refs.

34458 (DOE/ER/13383—1) Photolytic processes for measurement of combustion heats of formation and reaction rates. Progress report. Halpern, J.B. (Howard Univ., Washington, DC (USA). Dept. of Chemistry). 1982. Contract FG05-85ER13383. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011450.

In the past nine months, construction of two vacuum and gas handling systems has been completed. CH_3ONO was prepared by the reaction of $NaNO_2$ and CH_3OH with 50% H_2SO_4 and was separated from the excess methanol by vacuum distillation. Photolysis of this molecule in the region of 210 nm leads to a methoxy radical and NO. Since the heat of formation of the CH_3ONO is known, this will give a good measure of the heat of formation of the methoxy radical. Another small system has been constructed to look at the absorption of free radicals created by excimer laser photolysis. 3 refs. (PLG)

34459 (LA-UR—86-1504) Laser photochemistry of gallium-containing compounds. Baughcum, S.L.; Oldenborg, R.C. (Los Alamos National Lab., NM (USA)). 1986. Contract W-7405-ENG-36. 28p. (CONF-860620—1). NTIS, PC A03/MF A01; GPO Dep. File Number DE86011269.

From Society of Photo-Optical Instrumentation Engineers international symposium: topics in optical and optoelectronic applied sciences and engineering; Quebec City, Canada (2 Jun 1986).

The production of gas-phase gallium atoms in the photolysis of trimethylgallium has been investigated at 193 nm and at other laser wavelengths. Ground state (4 $^2P^0$/sub 1/2) and metastable (4 $^2P^0$/sub 3/2/) gallium atoms are detected using laser-induced fluorescence techniques. Our results indicate that gallium atoms continue to be produced at long times after the laser pulse. The observed dependence on photolysis laser fluence, trimethylgallium pressure, and buffer gas pressure are consistent with a mechanism in which highly excited gallium methyl radicals undergo unimolecular decomposition to produce gallium atoms. Since this process is observed to happen on the time scale of hundreds of microseconds, these results have important implications for studies of metal deposition and direct laser writing by laser photolysis of organometallic compounds. 31 refs., 5 figs.

34460 (PNL-SA—13597) Reactions of the thiophenoxy radical from the thermal and photolytic decomposition of phenyldisulfide. Alnajjar, M.S.; Franz, J.A. (Pacific Northwest Labs., Richland, WA (USA)). Dec 1985. Contract AC06-76RL01830. 10p. (CONF-860425—32). NTIS, PC A02/MF A01; GPO Dep. File Number DE86011136.

From 191. American Chemical Society national meeting; New York, NY, USA (13 Apr 1986).

The importance of sulfur-containing constituents or additives on the thermal degradation of coal has been recognized by many investigators. Stock and co-workwrs in a study of the hydrogen atom transfer reactions of tetralin-d_{12} with coal, diphenylmethane, and other coal model-compounds have shown that sources of thiyl radicals such as benzylphenylsulfide significantly accelerate the rate of hydrogen shuttling between benzylic positions of model structures. Studies of deuterium exchange between deuterated donors and coals suggest that a higher sulfur content is correlated with a more rapid exchange of benzylic hydrogen with the deuterated donor. The disulfide $\rightleftharpoons$ thiophenoxy radical equilibrium, which models an important family of equilibrating sulfur-center radicals present during liquefaction of sulfur-containing coals, provides facile mechanisms for rapid hydrogen transfer, displacement and condensation reactions leading to enhanced cleavage of aralkyl structure on the one hand, and retrograde formation of nearly inert thiophene structures on the other hand. further work is underway to determine the kinetics of 1,2-aryl migrations of phenyl from sulfur to carbon and to detect the intermediacy (if any), of 9-S-3 sulfur-centered radicals involved in radical displacement reactions at sulfur.

34461 Quenching of dye-sensitized photocurrents at ZnO semiconductor eletrodes. Spitler, M.T. (Solar Energy Research Institute, Golden, CO). *Journal of Physical Chemistry;* **90**: No. 10, 2156-2159(8 May 1986).

With the use of ZnO single-crystal electrodes in an attenuated total reflection arrangement, it has been confirmed that the low quantum efficiency Phi of photocurrents sensitized by rhodami ıe B and rose bengal is attributable to a fast back-reaction between the oxidized dye and electrons in surface traps. This conclusion is based upon the observation that Phi is a constant function of electrode surface coverage Theta down to Theta = 0.001 where energy-transfer quenching is negligible. Two different types of surface sites are found, one which leads to an efficient sensitization of photocurrent by the adsorbed dye and another which leads to the rapid back-reaction. These sites are distinguishable by their different heats of adsorption. 17 references, 4 figures.

34462 Excimer formation from triplet-triplet annihilation reactions of the lowest-lying triplet excited state in aluminum(III), silicon(IV), and metal-free phthalocyanines: medium and magnetic field effects on the rate of reaction. Frink, M.E.; Geiger, D.K.; Ferraudi, G.J. (Univ. of Notre Dame, IN). *Journal of Physical Chemistry;* **90**: No. 9, 1924-1927(24 Apr 1986).

The relaxation kinetics of aluminum(III), silicon(IV), and metal-free phthalocyanine (PcH_2) have been investigated by both conventional and laser flash photolysis. The observed excited-state decay kinetics are shown to be controlled by the excited-state concentration, the nature of the solvent, and the presence of an external magnetic field. Triplet-triplet annihilation is shown to be a dominating factor in the excited-state scheme. The second-order deviations observed in the relaxation kinetics of the phthalocyanines under various conditions are discussed in terms of an excimer-[(^{3}E/sub u/)Pc* + (^{3}E/sub u/)Pc* $\rightarrow$ (^{1}A/sub 1g/) [Pc-Pc]*] mediated mechanism. 34 references, 5 figures, 2 tables.

34463 Formation of silylgermane by a silylene insertion reaction in the infrared photochemistry of monosilane-monogermane mixtures. Zhu, P.; Piserchio, M.; Lampe, F.W. (Pennsylvania State Univ., University Park). *Journal of Physical Chemistry;* 89: No. 25, 5344-5347(5 Dec 1985).

The infrared photodecomposition at 944.2 cm^{-1} of silane-germane mixtures has been studied over a pressure range of 24-46 torr and over a temperature range of 295-356 K. The products observed are hydrogen, disilane, silylgermane, trace amounts of trisilane, and solid polymeric material. Digermane formation was not observed. The primary photodecomposition of SiH_4 is to $SiH_2 + H_2$; this is followed by insertion of SiH_2 into an Si-H bond of SiH_4 or a Ge-H bond of GeH_4 to form Si_2H_6 or SiH_3GeH_3, respectively. On the basis of these studies, the competitive rates of SiH_3GeH_3 and Si_2H_6 formation as a function of temperature and those in the literature relative to the absolute rate of insertion of SiH_2 into SiH_4, the value k_3 = 10/sup 10.4+/-0.5/ exp(-10.7 +/- 5.3 x 10^3 J/RT) L mol^{-1} s^{-1} for the specific reaction rate of insertion of SiH_2 into a Ge-H bond of germane is derived. 30 references, 4 figures.

34464 Q-band (35 GHz) EPR results on the nature of A_1 and the electron spin polarization in photosystem I particles. Thurnauer, M.C.; Gast, P. (Argonne National Lab., IL). *Photobiochemistry and Photobiophysics;* 9: 29-38(1985). Contract W-31-109-ENG-38.

The nature and the number of electron acceptors which precede the iron-containing acceptors in photosystem I (PS I) are not known. Recently, it was proposed that there are two, the so-called A_0 and A_1. Information about these early acceptors has come primarily from electron paramagnetic resonance (EPR) studies of (i) the signal(s) which has been attributed to A_0^- and/or A_1^-, and (ii) the transient electron spin polarized (ESP) EPR signals observed from PS I. A problem in interpreting both kinds of experiments has been lack of sufficient spectral resolution at the more common X-band microwave frequency (9 GHz). Therefore, EPR experiments have been performed at high microwave frequency (35 GHz) on deuterated PS I particles which lack the acceptors X and centers A and B. The results show that (i) one of the early acceptors, probably A_1, shows considerable g-anisotropy similar to that of a reduced quinone, and (ii) at 35 GHz, the ESP pattern of the transient signal does not change as predicted from the radical pair mechanism which has been used to analyze these signals. In the light of these two observations, the mechanism of formation of ESP in terms of PS I primary reactions must be reinvestigated. 50 references, 3 figures.

34465 Liquid junction photovoltaic devices utilizing organic thin film electrodes. Linkous, C.A.; Armstrong, N.R. (Brookhaven National Lab., Upton, NY). *Progress in Batteries and Solar Cells;* 384-388(1983).

The application of organometallic phthalocyanines as p-type semiconductors in photoconductive and photovoltaic devices is described. The advantages of liquid junction photovoltaic devices are also described. Preliminary voltammetric data exemplifying types of photoresponse for various phthalocyanine derivatives are given. 21 references, 3 figures.

4006 Radiation Chemistry

34466 (DOE/ER/00038—2842) University of Notre Dame quarterly report, January 1, 1986-March 31, 1986. (Notre Dame Univ., IN (USA). Radiation Lab.). 30 Apr 1986. Contract AC02-76ER00038. 41p. (NDRL—2842). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86010668.

Fifty-seven abstracts are presented in the fields of radiation chemistry and photochemistry. In addition, a list of publications, external talks, and presentations are included. (PLG)

34467 (INIS-mf—10105, pp 67) Infrared spectra of irradiated ion-exchange resins. Sourkova, L.; Habersbergerova, A.; Moravec, J. (Ustav Jaderneho Vyzkumu CSKAE, Rez, Czechoslovakia). 1984. NTIS (US Sales Only), PC A02/MF A01. File Number DE86702155. (CONF-8406249—Vol.2-Absts.).

From 7. Czechoslovak spectroscopic conference and 8. CANAS; Ceske Budejovice, Czechoslovkia (18 Jun 1984).

34468 Spur reaction of .H. A CIDNP study of HD in water radiolysis. Trifunac, A.D.; Chiu, T.M.; Lawler, R.G. (Argonne National Lab., IL). *Journal of Physical Chemistry;* 90: No. 9, 1871-1874(24 Apr 1986). Contract W-31-109-ENG-38.

CIDNP has been detected from HD formed during radiolysis of HOD/D_2O solutions under conditions where diffusive reaction of the corresponding atoms is prevented by the addition of scavengers, thus proving that at least some of the molecular hydrogen produced in spurs arises from the reaction of hydrogen atoms. The sign of the CIDNP multiplet effect indicates that the H and D atoms formed within the spur have uncorrelated electron spins. The observation of a net CIDNP polarization in HD in the presence of CD_3OD is explained by reaction of e/sub aq/$^-$ and .H. 26 references, 3 figures, 1 table.

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REFER ALSO TO CITATION(S) 33872, 34378, 34382, 34396, 34399, 34406, 35139, 35150, 35151

34469 (AERE-R—11632) Reduction of uranium oxides with carbon monoxide and hydrogen. Duck, M.J. (UKAEA Atomic Energy Research Establishment, Harwell. Chemistry Div.). Sep 1985. 69p. H.M. Stationery Office, London price Pound 6.00.

A kinetic study of the reduction of UO_2, U_3O_8 and U_4O_9 to UO_2 has been carried out using both CO and H_2, with particular reference to the least characterized and understood of the six reactions - the reduction of U_4O_9 with CO. Some reductions of UOsub(2+x) were also studied (but with CO only). The reductions proceeded more readily in CO than in H_2 - reactions of a given rate occurring about 100°C lower in CO than in H_2 for both UO_3 and U_3O_8. The difference was less for U_4O_9, being about 35°C, but this value is less accurate than those of other reactions since the rates of reduction of U_4O_9 with CO were far less reproducible than those obtained with all the other reactions studied, making comparisons uncertain. A further complication with U_4O_9 was the tendency for induction periods to occur when CO was used. It is suggested that the difficulties encountered with U_4O_9 stem from the complex nature of its structure.

34470 (INIS-BR—461, pp 37) **Production of ^{67}Ga.** Chamma, D.F.S.; Silva, A.G. da; Souza, A.S.F. de. 1984. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. File Number DE86702106.

In Annual technical report of Nuclear Engineering Institute - Physics Department - 1984.

34471 (INIS-BR—461, pp 38-39) **Production of ^{111}In.** Chamma, D.F.S.; Silva, A.G. da; Teixeira, F.C.M.; Souza, A.S.F. de. 1984. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. File Number DE86702106.

In Annual technical report of Nuclear Engineering Institute - Physics Department - 1984.

34472 (INIS-BR—461, pp 39) **Production of ^{123}I.** Britto, J.L.Q. de. 1984. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. File Number DE86702106.

In Annual technical report of Nuclear Engineering Institute - Physics Department - 1984.

34473 (INIS-BR—461, pp 40-42) **Development of a new method for ^{201}Tl production.** Britto, J.L.Q. de; Braghirolli, A.M.S.; Silva, A.G. da. 1984. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. File Number DE86702106.

In Annual technical report of Nuclear Engineering Institute - Physics Department - 1984.

34474 (INIS-BR—461, pp 43-44) **Optimization of the ^{77}Br production process.** Bastos, M.A.V.; Silva, A.G. da. 1984. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. File Number DE86702106.

In Annual technical report of Nuclear Engineering Institute - Physics Department - 1984.

34475 (INIS-BR—461, pp 44-45) **Labelling of ^{77}Br - 'Rosa de Bengala'.** Bastos, M.A.V. 1984. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. File Number DE86702106.

In Annual technical report of Nuclear Engineering Institute - Physics Department - 1984.

34476 (INIS-BR—461, pp 45) **Preparation and recovery of thallium targets for ^{201}Tl production.** Almeida, G.L. de; Braghirolli, A.M.S.; Silva, A.G. da. 1984. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. File Number DE86702106.

In Annual technical report of Nuclear Engineering Institute - Physics Department - 1984.

34477 (INIS-BR—461, pp 46-47) **Measurement of the yield labelling of the O-I-hippuric acid (O-IH) with ^{123}I using HPLC.** Britto, J.L.Q. de. 1984. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. File Number DE86702106.

In Annual technical report of Nuclear Engineering Institute - Physics Department - 1984.

34478 (INIS-mf—10105, pp 12-13) **Use of infrared spectroscopy in analysis of some chemical materials and processes related to nuclear research.** Moravec, J. (Ustav Jaderneho Vyzkumu CSKAE, Rez, Czechoslovakia). 1984. NTIS (US Sales Only), PC A02/MF A01. File Number DE86702155. (CONF-8406249—Vol.2-Absts.).

From 7. Czechoslovak spectroscopic conference and 8. CANAS; Ceske Budejovice, Czechoslovkia (18 Jun 1984).

34479 (INIS-mf—10111, pp 32) **Complex evaluation of radionuclide impurity levels in sodium sup(99m)Tc-pertechnetate from ^{99}Mo-sup(99m)Tc extraction generator.** Silar, J. (Karlova Univ., Prague, Czechoslovakia. Biofyzikalni Ustav). May 1985. (In Czech). NTIS (US Sales Only), PC A03/MF A01. File Number DE86701997. (CONF-8505256—Absts.).

From IAA conference on instrumental activation analysis; Klucenice, Czechoslovakia (12 May 1985).

34480 (INIS-mf—10111, pp 34) **Radioactive impurities in eluate from new type of sup(99m)Tc generator - "Amertec 2 - Mcc 20" by Radiochemical Centre Amersham.** Kovar, P.; Dryak, P.; Plchova, L.; Novotna, P.; Kokta, L. (Ustav pro Vyzkum, Vyrobu a Vyuziti Radioisotopu, Prague, Czechoslovakia). May 1985. (In Czech). NTIS (US Sales Only), PC A03/MF A01. File Number DE86701997. (CONF-8505256—Absts.).

From IAA conference on instrumental activation analysis; Klucenice, Czechoslovakia (12 May 1985).

34481 (KAERI/MR—81/84) **Production and development of radioisotopes.** Kim, Young Kuk; Lee, Jong Du; Bang, Hong Sik; Han, Hyon Soo; Park, Mee Sook; Suh, Choon Ha. (Korea Advanced Energy Research Inst., Daeduk (Republic of Korea)). Apr 1985. 17p. (In Korean). NTIS (US Sales Only), PC A02/MF A01. File Number DE86702176.

Radioisotopes produced by TRIGA MARK III REACTOR were supplied to hospitals, science institutes, universities, nondestructive test industries and so on in Korea. In 1984, 385.5 Ci (207 x 10^6 won) of non-sealed radioisotopes, mainly radiopharmaceuticals and 480 Ci (15 x 10^6 won) of radiation sources for non-destructive test, were supplied to users. The total activity of supplied radioisotopes showed 5% increase over last year. In order to increase activity of ^{192}Ir sources, the relationship of amounts of Ir in irradiated target and activity of yields was studied. Because of competition between home made ^{99}Tc extracted from low activity ^{99}Mo and imported ^{99}Mo-^{99}Tc generator, the negotiation with AECL (Atomic Energy Canada Limited) is carried on technical transfer of ^{99}Mo-^{99}Tc generator production.

34482 (UCID—20489) **Tritium gettering from air with hydrogen uranyl phosphate.** Souers, P.C.; Uribe, F.S.; Stevens, C.G.; Tsugawa, T.T. (Lawrence Livermore National Lab., CA (USA)). Aug 1985. Contract W-7405-ENG-48. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011011.

The managers of all tritium facilities now worry about their emissions into the atmosphere. The only method for cleaning tritium out of air is to catalyze the formation of tritiated water which is adsorbed, along with the overwhelming bulk of naturally occurring water vapor, on a zeolite molecular sieve. This method generally costs several million dollars for a small system, because of the necessary steel ducting, compressors and holding tanks. We have long had the dream of finding another getter that might be cheaper to use and would, hopefully, not make tritiated water (HTO). In a previous paper, we discovered that hydrogen uranyl phosphate (HUP, with the formula $HUO_2PO_4 \times 4H_2O$) getters 1 ppM of tritium gas out of moist air. This makes HUP the first known "direct" tritium getter to work in air. However, the tritium enters a hydroxyl network within the HUP, so that it is effectively still in "water" form within the HUP. Worse yet, we found up to 10% tritiated water formed during the previous gettering experiments. HUP is unusual in possessing the exceptionally low vapor pressure of 0.6 torr water vapor at 298°K. This allows HUP to be used in fairly dry environments. 14 refs., 3 figs., 2 tabs.

34483 **Kinetics of reduction of plutonium(VI) and neptunium(VI) by sulfide in neutral and alkaline solutions.** Nash, K.L.; Cleveland, J.M.; Sullivan, J.C.; Woods, M. (Geological Survey, Denver, CO). *Inorganic Chemistry;* **25**: No. 8, 1169-1173(9 Apr 1986). Contract W-31-109-ENG-38.

The rate of reduction of plutonium(VI) and neptunium(VI) by bisulfide ion in neutral and mildly alkaline solutions has been investigated by the stopped-flow technique. The reduction of both of these ions to the pentavalent oxidation state appears to occur in an intramolecular reaction involving an unusual actinide(VI)-hydroxide-bisulfide complex. For plutonium the rate of reduction is 27.4 (+- 4.1) s^{-1} at 25°C with $\Delta H^* = +33.2$ (+- 1.0) kJ/mol and $\Delta S^* = -106$ (+- 4) J/(mol K). The apparent stability constant for the transient complex is 4.66 (+- 0.94) x 10^3 M^{-1} at 25°C with associated thermodynamic parameters of $\Delta H/sub\ c/ = +27.7$ (+- 0.4) kJ/mol and $\Delta S/sub\ c/ = +163$ (+- 2) J/(mol K). The corresponding rate and stability constants are determined for the neptunium system at 25°C (k_s = 139 (+- 30) s^{-1}, K/sub c/ = 1.31 (+- 0.32) x 10^3 M^{-1}), but equivalent parameters cannot be determined at reduced temperatures. The reaction rate is decreased by bicarbonate ion. At pH > 10.5, a second reaction mechanism, also involving a sulfide complex, is indicated.

34484 **Decontamination analysis of a radiologically contaminated site.** Tawil, J.J.; Strenge, D.L. (Pacific Northwest Lab., Richland, WA). pp 6001-6009 of Computer applications in health physics. Kathren, R.L.; Higby, D.P.; McKinney, M.A. Richland, WA; Health Physics Society (1984). (CONF-840202—).

From 17. midyear topical meeting of the Health Physics Society; Pasco, WA, USA (5 Feb 1984).

This paper presents a post-exercise analysis of decontamination options for the NUWAX-83 exercise site. Held in May 1983, the purpose of NUWAX-83 was to evaluate the ability of federal, state and local officials to respond to an accident involving nuclear weapons. A computer program, called DECON, was developed by Pacific Northwest Laboratory and used to conduct the decontamination analysis in November 1983. DECON was designed to assist personnel engaged in the planning of decontamination activities. The many features of DECON that are demonstrated in this paper contribute to its potential usefulness as a planning tool for site restoration. Strategies that are analyzed with DECON include: 1) using a Quick-Vac option, under which exterior surfaces are vacuumed before it rains; 2) protecting surfaces against precipitation; 3) prohibiting specific operations on selected surfaces; 4) requiring

that specific methods be used on selected surfaces; 5) evaluating the trade-off between cleanup standards and decontamination costs; and 6) varying clean-up standards according to expected human exposure to the surface.

34485 **Microcalorimetric measurement of reaction enthalpies in solutions of uranium and neptunium compounds.** Schreiner, F.; Friedman, A.M. (Argonne National Lab., IL). pp 127-128 of IUPAC conference on chemical thermodynamics. Hamilton, Ontario; McMaster University (1984). (CONF-840807—).

From Conference on chemical thermodynamics and 39. calorimetry conference; Hamilton, Canada (13 Aug 1984).

The formation of complexes of uranyl and neptunyl(VI) ions with selected anions has been studied by titration microcalorimetry. The measurements were carried out with a computer-controlled microcalorimeter on solution volumes in the range 1.5 to 2.5 cm^3, containing typically 0.25 mmol of the species of interest. The small volume renders the calorimeter useful for the measurement of uncommon and strongly radioactive substances. Enthalpy changes were obtained for a number of reactions in which anions such as SO_4^{2-}, HCO_3^-, and CO_3^{2-} act as ligands bound to uranyl, UO_2^{2+}, and neptunyl (VI), NpO_2^{2+}, ions. The calorimetric technique has also been applied to the measurement of enthalpies of solution of insoluble salts in slurries. The results of the calorimetric determinations are interpreted in terms of the stoichiometry of the complexing reactions and of the stability of complex ions.

34486 **Enthalpy of formation of americium sesquioxide: systematics of actinide sesquioxide thermochemistry.** Morss, L.R.; Sonnenberger, D.C. (Argonne National Lab., IL). pp 130 of IUPAC conference on chemical thermodynamics. Hamilton, Ontario; McMaster University (1984). (CONF-840807—).

From Conference on chemical thermodynamics and 39. calorimetry conference; Hamilton, Canada (13 Aug 1984).

The enthalpy of formation of hexagonal Am_2O_3 has been determined to be -(1692 +/- 15) kJ x mol^{-1} by solution microcalorimetry. Systematic comparison of the measured enthalpies of formation of hexagonal Pu_2O_3 and Am_2O_3, monoclinic Cm_2O_3, and all lanthanide sesquioxides has been utilized to develop a predictive understanding of stability relationships among all actinide sesquioxides and other actinide oxides.

34487 **Determination and interpretation of metal-ligand bond disruption enthalpies in organoactinide compounds.** Morss, L.R.; Sonnenberger, D.C.; Marks, T.J.; Bruno, J.W. (Argonne National Laboratory, IL). pp 130-131 of IUPAC conference on chemical thermodynamics. Hamilton, Ontario; McMaster University (1984). (CONF-840807—).

From Conference on chemical thermodynamics and 39. calorimetry conference; Hamilton, Canada (13 Aug 1984).

An isoperibol batch-titration calorimeter with an inert atmosphere that was constructed to measure enthalpies of solution and of solvolysis of air-sensitive organoactinide compounds is described. Reaction enthalpies obtained by titration calorimetry are presented for alcoholysis with solutions of t-butanol and trifluoroethanol of compounds of the general formulas Cp_3MR and Cp'_2MR_2. In these compounds, M = Th or U, Cp is cyclopentadienyl (C_5H_5), Cp' is pentamethylcyclopentadienyl [$C_5(CH_3)_5$], and R is hydrocarbyl, amide, or hydride. Disruption enthalpies of thorium-carbon, thorium-hydrogen, and uranium-carbon bonds in these compounds are calculated and interpreted in terms of properties of the actinide ions, ligand geometry, and coligands.

34488 **Thermochemical data for nuclear waste disposal.** Phillips, S.L. (Lawrence Berkeley Lab., CA). pp 150 of IUPAC conference on chemical thermodynamics. Hamilton, Ontario; McMaster University (1984). (CONF-840807—).

From Conference on chemical thermodynamics and 39. calorimetry conference; Hamilton, Canada (13 Aug 1984).

Results are given on a compilation of critically evaluated stability constants for application to the disposal of nuclear wastes. Hydrolysis and formation constants of americium and neptunium are emphasized along with carbon chemistry. Data are discussed for predicting stability constants to 623 K, and at ionic strengths over the range 0 to 3 mol x kg^{-1}.

34489 **Enthalpy of formation of uranium tetrafluoride by fluorine bomb calorimetry.** Johnson, G.K. (Argonne National Lab., IL). pp 94 of IUPAC conference on chemical thermodynamics. Hamilton, Ontario; McMaster University (1984). (CONF-840807—).

From Conference on chemical thermodynamics and 39. calorimetry conference; Hamilton, Canada (13 Aug 1984).

The enthalpy of combustion or uranium tetrafluoride in fluorine according to the reaction $UF_4(cr) + F_2(g) \rightarrow UF_6(cr)$, was measured in a bomb calorimeter. The samples of UF_4 used in the combustion were prepared by thermal reduction of the product obtained from the reaction of UF_6 and PF_3. Use of tungsten as an auxiliary combustion aid insured complete reaction of the UF_4. The measured enthalpy of the above reaction, -(287.1 +/- 0.9) kJ x mol^{-1}, was used to derive Δ/sub f/H/sub m/°(UF_4, cr, 298.15 K) = -(1910.6 +/- 2.0) kJ x mol^{-1}.

34490 **Heat capacity (8 to 350 K) of PuH/sub 1.9/, heat capacity (340 to 600 K) of PuH/sub 2.0/, and recommended thermodynamic properties of PuH_2 to 600 K.** Oetting, F.L.; Hodges, A.E. III; Haschke, J.M.; Flotow, H.E. (Rockwell International, Golden, CO). pp 94-95 of IUPAC conference on chemical thermodynamics. Hamilton, Ontario; McMaster University (1984). (CONF-840807—). Contract AC04-76DP03533;W-31-109-ENG-38.

From Conference on chemical thermodynamics and 39. calorimetry conference; Hamilton, Canada (13 Aug 1984).

The low-temperature heat capacity of PuH/sub 1.9/, where the major plutonium isotope was ^{242}Pu, has been determined from 8 to 350 K. The results of this investigation of PuH/sub 1.9/ at 298.15 K have been adjusted to correspond to stoichiometric plutonium dihydride, PuH_2. The following molar thermodynamic quantities were obtained at 298.15 K: the heat capacity, C/sub p/°,m(T), (43.50 +/- 0.44) J x K^{-1} x mol^{-1}; the standard entropy, S/sub m/°(T), (72.84 +/- 0.73) J x K^{-1} x mol^{-1}; the enthalpy increment H/sub m/°(T) - H/sub m/°(O), (8593 +/- 86) J x mol^{-1}; and the Gibbs energy function, -[(G/sub m/°(T) - H/sub m/°(O)]/T, (44.02 +/- 0.44) J x K^{-1} x mol^{-1}. These thermodynamic quantities for PuH_2 at 298.15 K, have been combined with the high-temperature heat capacities (340 to 600 K) on a sample of PuH/sub 2.0/, where the major plutonium isotope was ^{239}Pu, to give the thermodynamic functions of PuH_2(cr) over the temperature range from 298.15 to 600 K.

34491 **Coordination chemistry of technetium as related to nuclear medicine.** Srivastava, S.C.; Richards, P. (Brookhaven National Lab., Upton, NY, USA). *Journal of the Indian Chemical Society;* 59: No. 11-12, 1262-1269(Nov-Dec 1982).

Significant advances have been made in the area of technetium coordination chemistry during the last five years. The main driving force behind this recent surge of interest in the field has been due to the practical application of technetium-99m in the rapidly growing speciality of nuclear medicine. Technetium-99 is one of the products of nuclear fission reactions, but it was the development of the molybdenum-99-technetium-99m generator about two decades ago that provided the basis for the development of radiopharmaceuticals routinely used in modern diagnostic applications. The chemistry of this element has proven to be quite rich owing to its multiple oxidation states and variable geometry. This can be attributed to its position in the middle of the periodic table. Diagnostic radiopharmaceuticals comprise predominantly III, IV and V oxidation states of Tc and involve a variety of coordination complexes. Even though the chemistry of Tc has been slow to evolve, recent synthetic advances have provided a more scientific basis for the study of a number of compounds with diverse coordination geometries and structures. Ligands with oxygen, nitrogen and sulfur donor atoms have been utilized to elucidate various aspects of the coordination chemistry of Tc. Single crystal X-ray structural analysis has been extensively used to characterize Tc complexes and thus construct a firm foundation for the study of synthetic and mechanistic aspects of the chemistry of this element.

4008 Combustion, Pyrolysis, And High-temperature Chemistry

34492 **(AD-A—163737/0/XAB) Mechanisms of combustion of hydrocarbon/alcohol fuel blends. Final report, 15 September 1982-30 September 1985.** Hamins, A.P. (California Univ., San Diego, La Jolla (USA). Dept. of Applied Mechanics and Engineering Sciences). Dec 1985. 103p. NTIS, PC A06/MF A01.

The results reported directly supports the U.S. Army's research and development program in alternative fuels. Liquid fuels that are homogeneous solutions of hydrocarbon and alcohol fuels are considered here. Since combustion of diesel fuel resembles that in a diffusion flame, and because turbulent nonpremixed combustion can be considered as a statistical collection of strained, laminar flamelets, studies were performed on the structure and mechanisms of extinction of strained, laminar diffusion flames and strained laminar partially premixed diffusion flames. Use of alternate fuels often results in soot formation which causes easy detection of the vehicle. Therefore, studies were also performed to clarify the chemical mechanisms of soot formation in diffusion flames. For a well controlled laboratory experiment it is essential that the composition of the fuel be known. Petroleum based fuels are often a blend of aromatics and aliphatic fuels. Therefore experiments were performed on representative fuels namely homogeneous solutions of heptane, toluene and methanol. Results were analyzed by use of asymptotic theories. The experimental apparatus is described in Chapter II. Results of the research are discussed in Chapters III - IX. Each chapter has a brief abstract describing the results.

34493 **(AD-A—163740/4/XAB) Prediction of overall chemical kinetic rate parameters near extinction for diffusion flames burning multicomponent fuels.** Hamins, A.; Seshadri, K. (California Univ., San Diego, La Jolla (USA). Dept. of Applied Mechanics and Engineering Sciences). 1984. 16p. NTIS, PC A02/MF A01.

A mixing rule is developed to predict extinction of a diffusion flame burning a multi-component fuel. The chemical reaction is approximated as a one-step process between each component of the fuel and the oxidizer, and the activation energy characterizing the reaction is presumed to be large. The mixing rule predicts the overall chemical kinetic rate parameters characterizing the gas phase oxidation of the multicomponent fuel, if the rate parameters for its components are known. To test the validity of the predictions, extinction experiments were performed on diffusion flames stabilized above heptane, toluene, methanol, and a number of homogeneous solutions (with different proportions of the components) of these fuels. Experimental and theoretical values for the overall activation energy for the solutions were found to agree to better than 5 percent, and the preexponential factors were found to agree to better than a factor of three.

34494 **(AD-A—163936/8/XAB) Variational transition state theory and tunneling calculations of potential-energy-surface effects on the reaction of O(3p) with H_2.** Truhlar, D.G.; Garrett, B.C. (Chemical Dynamics Corp., Columbus, OH (USA)). 1984. 12p. NTIS, PC A02/MF A01.

Rate constants for the important combustion O(3P state) + H_2 yield OH + H are calculated using variational transition state theory (VTST) with adiabatic and least-action ground-state transmission coefficients (VTST/G). Five different potential energy surfaces were considered and rates were computed for temperatures from 200 to 1400 K. First, collinear VTST/G calculations were compared with accurate quantum-mechanical ones to assess the accuracy of the dynamical and energetic approximations, which include the no-recrossing assumption of generalized transition state theory, semiclassical methods for tunneling calculations, and a Morse approximation for quantizing the generalized-transition state theory, stretching vibrations. For all five surfaces, which show widely different behavior, the calculations with the least-action ground-state transmission coefficients agree with the accurate quantal results within a factor of 2.9 in all cases. Next the three-dimensional VTST/G calculations were compared with experiment in an attempt to assess the validity of the potential energy surfaces. From this work, only one of the five surfaces could be definitively eliminated. The three-dimensional reaction was found to be dominated by tunneling at room temperature and nearby for all five surfaces. For the calculations on the most accurate ab initio potential energy surface, 60% of the ground-state reaction proceeds by tunneling even at 400 K.

34495 **(AD-A—164491/3/XAB) Analysis of combustion of a porous medium. Master's thesis.** (Naval Postgraduate School, Monterey, CA (USA)). Dec 1985. 61p. NTIS, PC A04/MF A01.

A numerical analysis of a heat transfer and combustion model for a porous medium within a circular cylinder is carried out. The basic mechanisms considered in the theory are: a carbon energy conservation equation, energy balance on air, and an oxygen mass balance equation, and an oxygen mass-balance equation. Heat-transfer mechanisms included in the model are conduction, convection, and radiation. A heat-generation term arising from combustion of the carbon is included in the model. Transport mechanisms for oxygen mass transfer are molecular diffusion and convective transport. The governing heat- and mass-transfer equations are solved numerically by the Galerkin formulation of the finite element method. The results show the effects of permeability, porosity, geometry, and initial condition on the behavior of the system.

34496 **(SAND—85-2872C) Titanium oxidation kinetics and the mechanism for thermal ignition of titanium-based pyrotechnics.** Erickson, K.L.; Rogers, J.W. Jr.; Ward, S.J. (Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 19p. (CONF-860739—6). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010987.

From 11. international pyrotechnics seminar; Vail, CO, USA (7 Jul 1986).

Previously published experimental studies proposed that thermal ignition of titanium-based pyrotechnics is controlled by the rate at which an initial oxide coating dissolves into the bulk metal as a result of molecular diffusion. The proposed dissolution mechanism was based primarily on the exotherms and ignition temperatures, which were about 793°K, observed using differential thermal methods involving heating rates of 0.33 K/s. Data from a more recent investigation of titanium oxidation kinetics at temperatures between 473 and 773°K showed that, for time scales on the order of minutes and temperatures near 773°K, titanium oxidation rates and, therefore, pyrotechnic ignition are determined by diffusion-controlled growth of a TiO_2 (rutile) layer adjacent to the gas-solid interface. They are not controlled by oxygen dissolution into the bulk metal. This result was based primarily on Auger depth profiles from isothermally oxidized titanium single crystals. It is further supported by the present work, in which a model for pyrotechnic response during differential thermal analysis experiments was derived using an oxidation rate expression based on growth of a TiO_2 layer. The model predicts exotherms which are consistent with those reported in the previously published experimental studies. 16 refs., 4 figs., 3 tabs.

34497 **(UCRL—93614) Developing simplified models of combustion chemistry by simulation with detailed chemical kinetics models.** Creighton, J.R. (Lawrence Livermore National Lab., CA (USA)). 13 Mar 1986. Contract W-7405-ENG-48. 9p. (CONF-860729—2). NTIS, PC A02/MF A01. File Number DE86008381.

From Summer computer simulation conference; Reno, NV, USA (28 Jul 1986).

Simulations with detailed chemical kinetics mechanisms were used to develop simplified models for the oxidation of simple fuels, with emphasis on methane. The first simplification was based on the observation that the concentrations of several radical species were in steady state so that they formed a "radical pool" where the concentrations of pool species track one another. During the induction period these concentrations grow exponentially. Simulations showed that as concentrations grow, non-linear terms due to specific reaction steps bring the entire radical pool to steady state and that thereafter the radical pool concentration is determined by the temperature. Simulations also show that all reactions with the same initial reactant concentrations reach the same steady state regardless of initial temperature or initial radical concentration. Because the rate of heat release is a function of the radical pool concentration,

the rate of temperature increase during this steady state is a function only of temperature with initial reactant concentrations as parameters. A model based on these simplifications reproduces much of the behavior of the detailed kinetics model in simulations of explosions and flames. 24 refs., 2 figs.

34498 **Effusion studies of the decomposition of zinc sulfate and zinc oxysulfate.** Brittain, R.D.; Lau, K.H.; Knittel, D.R.; Hildenbrand, D.L. (SRI International, Menlo Park, CA). *Journal of Physical Chemistry;* **90**: No. 10, 2259-2264(8 May 1986).

The torsion-effusion method has been used to measure the SO_3 decomposition pressure over the crystalline solids $ZnSO_4$ and ZnO x $2ZnSO_4$ in the range of about 800 to 900 K. SO_3 is the only detectable vapor species under these conditions. Vapor composition was verified by mass spectrometry and by molecular weights obtained from simultaneous torsion and mass-loss effusion measurements. The vaporization process is kinetically limited in two respects, since SO_2 and O_2 are the dominant gaseous products at equilibrium and since the SO_3 effusion pressures show a pronounced dependence on orifice size. Equilibrium SO_3 pressures over both $ZnSO_4$ and ZnO x $ZnSO_4$, derived by extrapolation of steady-state pressures to zero orifice area, are more than a factor of five lower than values calculated from established thermodynamic data, indicating the likelihood that the product solid phases are formed in a finely divided metastable condition. Addition of a few mole percent of Pt powder to ZnO x $2ZnO_4$ led to a dramatic pressure increase and to effusing gas compositions consistent with decomposition to SO_2 and O_2, while for $ZnSO_4$ the effusing gas was converted to SO_2 and O_2 but the pressure increase was smaller and not entirely reproducible. 23 references, 2 figures, 6 tables.

34499 **Reaction zone thickness of premixed laminar flames.** O'Rourke, P.J.; Stein, L.R. (Los Alamos National Lab., NM). *Combustion Science and Technology;* **38**: 337-343(1984).

The structure of planar premixed laminar flames in a gas undergoing a single chemical reaction whose activation energy is large is discussed. In agreement with previous studies, it was found that the reaction zone occupies a significant fraction of the total flame zone thickness for realistic values of the dimensionless activation energy β. This is illustrated graphically in plots of the convection, diffusion, and heat-release terms of the enthalpy equation. The implications of a thick reaction zone for the numerical modeling of laminar flames and for results obtained by the method of activation energy asymptotics are discussed.

34500 **Burning rates of linear fuel droplet arrays.** Labowsky, M. (Yale Univ., New Haven, CT). *HTD [Publication] (American Society of Mechanical Engineers);* No. 80-WA/NT-34, 1-6(1981). Contract FG01-78ET11384.

From Winter annual meeting of the American Society of Mechanical Engineers; Chicago, IL, USA (16-21 Nov 1980).

Recent experimental measurements of the burning rates of linear fuel droplet arrays are compared with those calculated by using the Method of Images (MOI) to solve the combustion transport equations. This comparison shows substantial agreement between the measured and calculated burning rates. In particular, the droplet burning rates decrease monotonically with decreasing droplet spacing. The fractional change in the burning rate with spacing is nearly independent of fuel type and ambient burning conditions. Further, the classical D^2-law, which states that the surface area of an isolated droplet decreases linearly with time, does not rigorously apply to interacting droplets. 25 references, 4 figures.

42 ENGINEERING

4201 General Engineering

REFER ALSO TO CITATION(S) 35372, 35378

34501 **(DOE/ER/13446—1) Mechanistic study of the effects of magnetic fields on scale formation. Progress report, September 1, 1985-August 30, 1986.** Katz, J.L. (Johns Hopkins Univ., Baltimore, MD (USA)). 15 May 1986. Contract FG02-85ER13446. 44p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86011285.

This progress report describes research sponsored by the Division of Advanced Energy Projects of the US Department of Energy, for the express purpose of: (1) examining the fundamental physics and processes that must be occurring if magnetic water treatment is a real phenomenon, (2) verifying that it actually does occur under at least some circumstances, and given verification of its existence, (3) developing a sufficiently deep understanding of the relevant processes so that magnetic water treatment can be successfully employed for useful social and economic purposes. In this report, we shall: (1) outline our working hypothesis, briefly reviewing the current state of knowledge concerning magnetic water treatment, and (2) describe our research and its near-future direction. 11 refs.

34502 **(EPRI-EM—4526) Electron beam processing of metals. State-of-the-art assessment. Final report.** Lalwaney, N.S. (Battelle Columbus Labs., OH (USA)). Apr 1986. 70p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920302.

Electron beam (EB)-based electrotechnologies use a high-energy electron beam as a processing tool - a stream of electrons moving at rates up to two-thirds the speed of light that can weld, melt, machine, drill, heat-treat, and cure a wide variety of materials. As a result, EB processing, mainly welding, is widely used in many industrial markets. Even though it is one of the newer electrotechnologies, its recent growth has been stable rather than spectacular, mainly due to its high initial capital costs. For many low-power applications (less than 5 to 6 kW), lasers have become a competing technology. The vacuum environment synonymous with EB technology is both a strength and a limitation of the process. The trend to automate the control of process parameters and work manipulation will continue. There will be no spectacular growth in the dollar sales of EB processing equipment, but EB processing will continue to have an important role in the metalworking and associated industries. 18 refs., 17 figs.

34503 **(SAND—85-2403) Response of a three-layered ring to an axisymmetric impulse.** Sagartz, M.J. (Sandia National Labs., Albuquerque, NM (USA)). May 1986. Contract AC04-76DP00789. 35p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86011016.

A modal solution for the axisymmetric response of a three-layered shell to an impulse load is derived. The outer and inner layers are each assumed to be thin and are separated by a relatively soft middle or core layer. Elasticity theory is used to treat the core layer while the inner and outer layers are governed by shell theory. Formulas for the circumferential stresses in the inner and outer layers and for the radial stress in the core are presented. A limited parameter study is included to demonstrate the use of the solution. Comments about the convergence of the series solution and its range of applicability are included. A listing of a computer program used to evaluate the series solutions is included in an Appendix.

34504 **(SAND—86-2069C) Random processes in mechanical testing.** Paez, T.L. (Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 44p. (CONF-8605105—1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86010101.

From 32. annual Institute of Environmental Sciences technical meeting; Dallas, TX, USA (6 May 1986).

This report consists of notes which summarize the discussion associated with the random processes associated with mechanical testing. (JDB)

34505 **(UCID—20275) Bearings only naval tracking.** Barth, M.J. (Lawrence Livermore National Lab., CA (USA)). Nov 1984. Contract W-7405-ENG-48. 94p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86011006.

Two commonly used Extended Kalman Filter tracking algorithms utilize the Relative Cartesian and Modified Polar coordinate systems. This report compares the two algorithms by exercising a destroyer-Submarine (DD/SS) computer simulation. A simple engagement geometry is employed which encompasses the major DD/SS options available. Error statistics are developed by Monte Carlo methods. Results are presented which show that the circular error depends upon the diagonal values of the error covariance matrix. The results also support (but do not establish) that the optimum DD manuevuer is that which minimizes the range while maximizing the bearing rate. 4 refs., 5 figs., 4 tabs.

34506 **(UCRL—50016-85-1) Mechanical Engineering Department technical abstracts for the period January-June 1985.** Woo, H.H. (ed.). (Lawrence Livermore National Lab., CA (USA)). Jan 1986. Contract W-7405-ENG-48. 55p. NTIS, PC A04/MF A01; GPO Dep. File Number DE86011356.

4202 Facilities And Equipment

REFER ALSO TO CITATION(S) 33641, 33759, 33831, 33833, 34044, 34045, 34047

34507 **(BNL—38145) Technology of thermal hypervelocity launchers.** Powell, J.R.; Horn, F.L.; Benenati, R.; Lowrey, A. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 35p. (CONF-8604147—10). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86011539.

From 3. symposium on electromagnetic launch technology; Austin, TX, USA (20 Apr 1986).

A new type of hypervelocity launcher is described, the Thermal Hypervelocity Launcher (THL). The THL uses stored thermal energy in a compact, lightweight particle bed heater to rapidly (milliseconds) heat a high pressure low molecular weight propellant (hydrogen or helium). The hot propellant then expands in a conventional barrel accelerating the projectile. The THL can achieve velocities up to ~12 km/sec. The technology of the THL is described, including experiments on thermal/hydraulics of particle bed heaters. An experiment is under construction that will demonstrate (May 1986) THL operation with 100 gram projectiles at 3 km/sec.

34508 **(CEA-CONF—8212) Statistical analysis of results obtained in efficiency control of purification systems since 1977 in the installations of the Nuclear Study Center of Saclay.** Bricard, P.; Leblanc, P.; Le Cann, J.P.; Perrin, J.C. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). Oct 1985. 13p. (In French). NTIS (US Sales Only), PC A02/MF A01. File Number DE86751884.

In application of laws relative to worker protection against ionizing radiations in nuclear facilities ventilation and filtration systems are inspected each year. To day about 1,000 tests effected on 80 systems allow a statistical study and show improvements obtained. Results of efficiency and flow rate are compared to released activity for the determination of risk for environment.

34509 **(CONF-860722—2) Flow-induced vibration of the SSME LOX posts.** Chen, S.S.; Jendrzejczyk, J.A. (Argonne National Lab., IL (USA)). 1986. Contract W-31-109-ENG-38. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86005567.

From ASME pressure vessel and piping conference and exhibit; Chicago, IL, USA (20 Jul 1986).

Cracking of liquid-oxygen (LOX) posts was observed in several evaluation tests. The design modification consists of attaching impingement shields to LOX posts in the upstream row. This has improved the vibration/fatigue problem of LOX posts. However, that modification results in an increased pressure drop that ultimately affects the lifetime of other components. This paper presents a preliminary assessment of the LOX post vibration problem including a review of relevant parameters, flow induced vibration mechanisms, and scoping calculation and experiment. 11 refs.

34510 **(DOE/NE—0065) Robotics and nuclear power. Report by the Technology Transfer Robotics Task Team.** (USDOE Assistant Secretary for Nuclear Energy, Washington, DC). Jun 1985. 80p. NTIS, PC A05/MF A01; GPO Dep. File Number DE86011376.

A task team was formed at the request of the Department of Energy to evaluate and assess technology development needed for advanced robotics in the nuclear industry. The mission of these technologies is to provide the nuclear industry with the support for the application of advanced robotics to reduce nuclear power generating costs and enhance the safety of the personnel in the industry. The investigation included robotic and teleoperated systems. A robotic system is defined as a reprogrammable, multifunctional manipulator designed to move materials, parts, tools, or specialized devices through variable programmed motions for the performance of a variety of tasks. A teleoperated system includes an operator who remotely controls the system by direct viewing or through a vision system.

34511 **(EGG-M—29985) CASTOR-V/21 PWR spent fuel storage cask performance test.** Creer, J.M.; Schoonen, D.H. (Pacific Northwest Labs., Richland, WA (USA); EG and G Idaho, Inc., Idaho Falls (USA)). 1986. Contract AC07-76ID01570. 28p. (CONF-860417—1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86011027.

From 3. international symposium/workshop on irradiated fuel storage; Seattle, WA, USA (8 Apr 1986).

Performance testing of a CASTOR-V/21 PWR spent fuel storage cask manufactured by Gesellschaft fur Nuklear Service (GNS) was performed as part of a cooperative program between Virginia Power and the US Department of Energy. The performance test consisted of obtaining cask handling experience and heat transfer, shielding, and limited fuel integrity data. Five heat transfer test runs were performed with 21 Surry reactor spent fuel assemblies generating approximately 28 kW. Test runs were performed with vacuum, nitrogen, and helium backfills in both vertical and horizontal orientations. Cask exterior surface gamma and neutron dose rates were measured with the cask fully loaded. Gas samples were obtained at the beginning and end of each run with nitrogen or helium backfills to verify fuel integrity. The heat transfer performance of the CASTOR-V/21 cask was exceptionally good. Peak clad temperatures with helium and nitrogen backfills in a vertical orientation and with helium in a horizontal orientation were less than 380°C. Vertical vacuum and horizontal nitrogen runs resulted in peak clad temperatures over 380°, but the temperatures were not excessively high (<425°C). The shielding performance of the cask met the design expectation of less than 200 mrem/h. Cask surface dose rates of <75 mrem/h can easily be established with minor gamma shielding design refinements if desired. Gas samples obtained during testing indicated no leaking fuel rods were present in the cask. It was concluded that the cask performed satisfactorily from heat transfer and shielding perspectives.

34512 (INIS-BR—461, pp 47-49) **Intercells transport systems.** Almeida, G.L. de; Soares, M.; Rautenberg, F.A.; Costa e Silva, A. 1984. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. File Number DE86702106.

In Annual technical report of Nuclear Engineering Institute - Physics Department - 1984.

34513 (INIS-BR—461, pp 51-53) **Machine for feeding, fractionation and automatic change of sterilizing filters.** Almeida, G.L. de. 1984. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. File Number DE86702106.

In Annual technical report of Nuclear Engineering Institute - Physics Department - 1984.

34514 (INIS-BR—461, pp 53-55) **Programable platform.** Almeida, G.L. de. 1984. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. File Number DE86702106.

In Annual technical report of Nuclear Engineering Institute - Physics Department - 1984.

34515 (INIS-BR—461, pp 55-56) **Unit of target preparation.** Almeida, G.L. de; Costa e Silva, A.; Rautenberg, F.A. 1984. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. File Number DE86702106.

In Annual technical report of Nuclear Engineering Institute - Physics Department - 1984.

34516 (KAERI/RR—436/84) **Prototypical fabrication of PWR spent fuel shipping cask.** Kwack, Eun Ho; Kim, Byung Ku; Kang, Hee Yung; Lee, Chung Young; Jeon, Kyeong Lak; Lee, Bum Soo. (Korea Advanced Energy Research Inst., Daeduk (Republic of Korea)). Feb 1985. 294p. (In Korean). NTIS (US Sales Only), PC A13/MF A01. File Number DE86702187.

This report describes the safety analysis for the spent fuel shipping cask, which is used to transfer a single fuel assembly discharged from PWR in operation in Korea. The contents cover the methods and the results of structural, thermal, thermo-hydraulic, radiation shield and criticality detail analysis. The safety evaluation has been made under the normal transportation and hypothetical accident conditions such as 30ft free drop, puncture, fire, immersion, penetration, corner drop, etc,. Some corrections in design are made, and a brief information for fabrication and transportation are obtained by the use of a 1/6 scale model. The design is based on one year cooling time of the spent fuel with 40,000 MWT/MTU maximum burnup, which gives 7.2KW decay heat and 1.6×10^6 ci/hr radiation intensity. The cask is composed of main body with the double closures, impact limiter and fuel basket. The inner shell, inner closure and valves constitute the pressure boundary of the containment. The inner, intermediate and outer shells, upper and lower forgings are made of stainless steel which compose the main body with lead for gamma shield and 50% ethylene glycol for neutron shield. The impact limiters are made of balsa wood on both end sides of the cask to protect the cask from a sudden shock in accidents during the transportation. The analysis results show that the cask is proved to retain its structural integrity within allowable stress and to be safe under the normal and hypothetical accident conditions, and the maximum dose rates of radiation at 2m distance from the surface of the cask are less than the required values. The weight will be 23.2 tons in dry and 27.8 tons in wet with fuel loaded. All the design data, calculated results for the structural integrity, shield and thermal analysis are shown in this report with the basic drawings.

34517 (KAERI/RR—451-5/84) **Radiation shielding structure design.** Park, H.H.; Moon, C.Y.; Youn, S.J.; Chang, D.H.; Kang, K.C. . (Korea Advanced Energy Research Inst., Daeduk (Republic of Korea)). Apr 1985. 289p. (In Korean). NTIS (US Sales Only), PC A13/MF A01. File Number DE86702179.

For the full scope post-irradiation examination (PIE) aiming at development, improvement and safety enchancement of various nuclear fuels, and examination of failed fuels, it is a current trend in the advanced countries that all the required PIE depend upon the hot cell side PIE in the large hot cell capable of handling fuel assembly rather than the poolside PIE at reactor side. Construction of large hot cell is expected in Korea in the future for PIE related to development of nuclear fuel and safe operation of power reactor. The objective of the project is a buildup of the hot cell engineering capability by means of reviewing published technical documents for KAERI post-irradiation examination facility (PIEF) and integrating them as a basic design guide of hot cell. In this consequence, independence in technical capability could be established for design and construction of hot cell which currently relies on oversea engineering service, and eventually engineering service fee being paid in foreign currency could be saved.

34518 (MLM—3343) **Qualification of flat cables made by reel-to-reel processing.** Thomes, J.A. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 30 Apr 1986. Contract AC04-76DP00053. 97p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86011365.

At the request of Los Alamos, 2500 Mound-fabricated slapper detonator cables were incorporated into an extensive test matrix called the Cable Qualification. The purpose of the Cable Qualification was threefold: (1) to test Mound's recently developed reel-to-reel tape processing under production conditions; (2) to "prove-in" the quality of the cables by testing their electrical integrity following various conditioning; and (3) to examine the effect induced on the cables by additional processing steps - diffusion bonding and nickel plating. The results of the Cable Qualification show: (1) Mound's reel-to-reel tape process is capable of fabricating a production quanitity of cables: (2) the cables performed well above acceptable electrical levels following all combinations of conditioning; and (3) there is a wide range of diffusion bonding parameters that will yield a good bond without adversely affecting the cable, and there were no adverse effects inflicted on the cable by the nickel plating process. Since the completion of the fabrication of the Cable Qualification Lot, improvements have been made to many of the reel-to-reel processes which will improve the efficiency of the tape process. 22 figs.

34519 (SAND—85-2798C) **Numerical model of the thermal processes leading to ignition in a pyrotechnic device.** Pierce, K.G.; Leith, J.R. (Sandia National Labs., Albuquerque, NM (USA); New Mexico Univ., Albuquerque (USA). Dept. of Mechanical Engineering). 1986. Contract AC04-76DP00789. 14p. (CONF-860739—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE86009626.

From 11. international pyrotechnics seminar; Vail, CO, USA (7 Jul 1986).

The predicted ignition behavior of a hot-wire initiated pyrotechnic device, as obtained from simple numerical models, is presented. The models are based on the heat diffusion equation with temperature dependent properties. The predictions of the model for the short-term responses of a specific pyrotechnic device are consistent with experimental results. The predictions of the long-term response differ significantly from experimental data. The causes of this difference are discussed, and a parametric study of the variables which have an effect on the ignition process is presented.

34520 (SAND—85-2814C) **CP DDT detonators: V. Output performance and analysis of multiple-out devices.** Lieberman, M.L.; Hughes, R.L.; Heames, L.E. (Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 22p. (CONF-860739—7). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010995.

From 11. international pyrotechnics seminar; Vail, CO, USA (7 Jul 1986).

The effects on device output of corner turning in pre- and post-detonation conditions have been evaluated via several experimental and analytical procedures for CP-loaded devices. The results imply that multiple-output detonators with designed differences in output and/or relative timing can be achieved. It has also been established that corner turning in the pre-detonation condition can be implemented in detonator designs. 18 figs.

34521 (SAND—85-2864C) **Percussion primer/DDT detonator.** Kopczewski, M.R.; Weinmaster, R.R. (Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 16p. (CONF-860739—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010477.

From 11. international pyrotechnics seminar; Vail, CO, USA (7 Jul 1986).

A detonator has been designed and tested using a commercial percussion primer as the input stimulus. The detonator uses a secondary DDT explosive to provide a detonation output. The detonator can be tailored to initiate with a range of mechanical input levels. 16 figs.

34522 **(SAND—86-0055C) Benchmarking the Q/TRAN thermal analysis computer code.** Manteufel, R.D.; Klein, D.E.; Yoshimura, H.R. (Texas Univ., Austin (USA); Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 12p. (IAEA-SM—286/95-P; CONF-860604—12). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010992.

From International symposium on the packaging and transport of radioactive materials (PATRAM '86); Davos, Switzerland (16 Jun 1986).

Q/TRAN, a new thermal analysis computer code, was examined for its use in modeling the responses of radioactive material shipping casks in accident conditions. A comparison between Q/TRAN and HEATING-6 was made using four benchmark problems chosen for their cask-like geometries and similarity to packaging thermal environments. HEATING-6 was chosen for comparison because HEATING-5, a predecessor to HEATING-6, was used in previous cask analyses. Modeling capabilities for each code are discussed as they relate to the four benchmark model problems. Q/TRAN was determined to be advantageous because of (1) its superior numerical algorithms and (2) the pre- and postprocessing capabilities (with PATRAN) that allow the graphic display of flexible meshing schemes and thermal results.

34523 **(SAND—86-1236C) Beneficial Uses Shipping System cask.** (Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 11p. (IAEA-SM—286/98; CONF-860604—15). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011057.

From International symposium on the packaging and transport of radioactive materials (PATRAM '86); Davos, Switzerland (16 Jun 1986).

The Beneficial Uses Shipping System (BUSS) cask is a Type B packaging currently under development at Sandia National Laboratories for the US Department of Energy (DOE). The cask will transport radioactive source capsules (CsCl and SrF2) to facilities such as sewage, food, and medical products irradiators. This paper describes the cask system and the analyses performed to predict the response of the cask in impact, puncture, and fire accident conditions as specified in the regulations. The cask prototype is being fabricated, and activities to obtain a certificate of compliance have been initiated.

34524 **(SAND—86-2075C) Optimizing header strength utilizing finite element analyses.** Burchett, S.N. (Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 22p. (CONF-860739—5). NTIS, PC A02/MF A01; GPO Dep. File Number DE86010476.

From 11. international pyrotechnics seminar; Vail, CO, USA (7 Jul 1986).

Finite element techniques have been successfully applied as a design tool in the optimization of high strength headers for pyrotechnic-driven actuators. These techniques have been applied to three aspects of the design process of a high strength header. The design process was a joint effort of experts from several disciplines including design engineers, material scientists, test engineers, manufacturing engineers, and structural analysts. Following material selection, finite element techniques were applied to evaluate the residual stresses due to manufacturing which were developed in the high strength glass ceramic-to-metal seal headers. Results from these finite element analyses were used to identify header designs which were manufacturable and had a minimum residual stress state. Finite element techniques were than applied to obtain the response of the header due to pyrotechnic burn. The results provided realistic upper bounds on the pressure containment ability of various preliminary header designs and provided a quick and inexpensive method of strengthening and refining the designs. Since testing of the headers was difficult and sometimes destructive, results of the analyses were also used to interpret test results and identify failure modes. In this paper, details of the finite element element techniques including the models used, material properties, material failure models, and loading will be presented. Results from the analyses showing the header failure process will also be presented. This paper will show that significant gains in capability and understanding can result when finite element techniques are included as an integral part of the design process of complicated high strength headers.

34525 **(SLAC/AP—52) Snakes, rotators, serpents and the octahedral group.** Fieguth, T. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Apr 1986. Contract AC03-76SF00515. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011146.

Specific configurations of horizontal and vertical bending magnets are given that, when acting on the spin polarization vector of a particle beam, generate a group of 24 operators isomorphic to the group of rotational symmetries of a cube, known as the octahedral group. Some of these configurations have the feature of converting transversely polarized beams to longitudinally polarized beams (or vice versa) at the midpoint of the configuration for, in principle, all beam energies. Since the first order optical transfer matrix for each half of these configurations is nearly that of a drift region, the external geometry remains unchanged and midpoint dispersion is not introduced. Changing field strengths and/or polarities allows a configuration to serve as either a Snake(1/sup st/ or 2/sup nd/ kind) or a Rotator, where in both cases the spin polarization is longitudinal at the midpoint. In this conceptualization, emphasis has been placed on electron beams and, indeed, for these beams some practical applications can be envisioned. However, due to the relatively high integrated field strengths required, application of these concepts to proton beams may be more promising.

34526 **(UCID—20764) TM/sub on/ mode evaluation in a cylindrical waveguide using a Fourier-Bessel series expansion.** Burkhart, S. (Lawrence Livermore National Lab., CA (USA)). 8 May 1986. Contract W-7405-ENG-48. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86011692.

The TE/sub on/ and TM/sub on/ modes of a cylindrical waveguide can be expanded in terms of waveguide normal modes using a Fourier-Bessel series expansion. The Fourier-Bessel series is developed here for TM/sub on/ modes. A computer program is demonstrated that takes ascii data from the CONDOR post processer THPLOT and does a Fourier-Bessel expansion on it. The accuracy of the expansion is also discussed.

34527 **(WTSD-TME—085-Vol.1) Phase 1 study of metallic cask systems for spent fuel management from reactor to repository. Volume I. Phase 1 study summary.** (Westinghouse Electric Corp., Madison, PA (USA). Waste Technology Services Div.). Feb 1986. Contract AC01-84RW00003. 105p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE86009645.

It was proposed to perform a systems evaluation of metallic cask systems in order to define and examine the use of various metallic cask concepts or combination of concepts for the overall inventory management of spent fuel starting with its discharge from reactors to its emplacement in geologic repositories. This systems evaluation occurs in three phases. This three phase systems evaluation leads to a definition and recommendation of a sound and practical metallic cask system to accomplish efficient and effective management of spent fuel in the back end of the nuclear fuel cycle. Phase 1 Study objectives: establish system-wide functional criteria and assumptions; perform the systems engineering needed to define the metallic cask concepts and their feasibility; perform a screening evaluation of the technical and economic merits of the concepts; and recommend those to be included for a more detailed systems evaluation in Phase 2. Phase 2 Study objectives: refine the system-wide functional criteria and assumptions; perform the design engineering needed to enhance the validity and workability of those concepts recommended in Phase 1; and perform a more detailed systems evaluation. Phase 3 Study objectives: conclude the systems evaluation and develop an implementation plan. Volume I presents an overview of the detailed systems evaluation presented in Volume II.

34528 **(WTSD-TME—085-Vol.2) Phase 1 study of metallic cask systems for spent fuel management from reactor to repository. Volume II. Systems evaluation.** (Westinghouse Electric Corp., Madison, PA (USA). Waste Technology Services Div.). Feb 1986. Contract AC01-84RW00003. 255p. NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE86009646.

The information contained in Volume II is organized and presented in the following order: Section 2.0, Scenario and System Descriptions: this section defines and describes the scenarios and systems and how they were combined into the study cases which were evaluated in the Phase 1 Study. Also included in this section are the system assumptions and a brief description of the system components highlighting the major cask components. Section 3.0, Economic Assessment: this section presents the economic assessment performed for the study cases defined in Section 2.0, including the economic assumptions, inputs, and results. Section 4.0, Technical Assessment: this section establishes a common set of criteria addressing major technical issues and presents a technical assessment of each system with respect to these criteria. Section 5.0, Systems Evaluation: this section examines and compares the results of the economic assessment, establishes and explains a comparative ranking for the systems based on the technical assessment of each, describes the Peer Advisory Group participation and use of their input in a multi-attribute decision analysis technique demonstration, and presents an evaluation of spent fuel transportation system impacts for each of the study cases. Section 6.0, Conclusions and Recommendations: this section presents the conclusions of this Phase 1 Study and presents the recommendations for Phase 2.

34529 **(WTSD-TME—085-Vol.3) Phase 1 study of metallic cask systems for spent fuel management from reactor to repository. Volume III. Appendices.** (Westinghouse Electric Corp., Madison, PA (USA). Waste Technology Services Div.). Feb 1986. Contract AC01-84RW00003. 722p. NTIS, PC A99. File Number DE86009647.

Volume III of this report contains the following Appendices: Spent Fuel Management System Functional Requirements and Criteria; Spent Fuel and Reactor Plant Data; Metallic Cask and Component Descriptions; PRDA Economic Analysis Program; Summary of Cost Results for Study Cases and Sensitivities; Metallic Cask and Component Thermal Analysis; Peer Advisory Group Evaluation and Methodology; and PRDA Radiological Analysis Program.

34530 **Shock wave absorber having apertured plate.** Shin, Y. W.; Ockert, C. E.; Wiedermann, A. H. (to The United States of America as represented by the United States Department of Energy). US Patent 4,562,036. 31 Dec 1985. Filed date 26 Aug 1983. vp.

PAT-APPL-526765.

The shock or energy absorber disclosed herein utilizes an apertured plate maintained under the normal level of liquid flowing in a piping system and disposed between the normal liquid flow path and a cavity pressurized with a compressible gas. The degree of openness (or porosity) of the plate is between 0.01 and 0.60. The energy level of a shock wave travelling down the piping system thus is dissipated by some of the liquid being jetted through the apertured plate toward the cavity. The cavity is large compared to the quantity of liquid jetted through the apertured plate, so there is little change in its volume. The porosity of the apertured plate influences the percentage of energy absorbed.

34531 **Method and apparatus for making superconductive magnet coils.** Borden, A. R. (to The United States of America as represented by the United States Department of Energy). US Patent 4,554,731. 26 Nov 1985. Filed date 7 Nov 1983. vp.

PAT-APPL-549379.

A curved, shell-type magnet coil, adapted to be used in a superconducting magnet, is wound by providing a mandrel having a tubular cylindrical mid-portion terminating at both ends in tapered end portions formed with longitudinal slots having flexible fingers therebetween. An elongated electrical conductor is wound around an elongated oval-shaped pole island engaged with the outside of the cylindrical mid-portion, to form a multiplicity of oval-shaped turns engaged with a 180-degree segment of the mandrel. The coil turns have longitudinal portions with curved portions therebetween, engaging the tapered end portions of the mandrel. Upon completion of the winding, tapered expansion members are fully inserted into the tapered end portions, to displace the flexible fingers outwardly into a cylindrical form and to displace the curved portions of the turns into a shape conforming to such cylindrical form while also exerting increased tension upon the turns to minimize draping of the turns and to enhance the mechanical integrity of the coil. A half cylinder clamp may then be employed to clamp the coil, whereupon the coil may be solified by the use of an epoxy adhesive.

34532 **Rotary multiposition valve.** Barclay, J. A.; Dyson, J. E. (to The United States of America as represented by the United States Department of Energy). US Patent 4,553,566. 19 Nov 1985. Filed date 6 Apr 1984. vp.

PAT-APPL-597802.

The disclosure is directed to a rotary multiposition valve for selectively directing the flow of a fluid through a plurality of paths. The valve comprises an inner member and a hollow housing with a row of ducts on its outer surface. The ducts are in fluid communication with the housing. An engaging section of the inner member is received in the housing. A seal divides the engaging section into a hollow inlet segment and a hollow outlet segment. A plurality of inlet apertures are disposed in the inlet segment and a plurality of outlet apertures are disposed in the outlet segment. The inlet apertures are disposed in a longitudinally and radially spaced-apart pattern that can be a helix. The outlet apertures are disposed in a corresponding pattern. As the inner member is rotated, whenever an inlet aperture overlaps one of the ducts, the corresponding outlet aperture overlaps a different duct, thus forming a fluid pathway.

34533 **SAMSIN: the next-generation servo-manipulator.** Adams, R.H.; Jennrich, C.E.; Korpi, K.W. (Sargent Industries, Red Wing, MN). *Transactions of the American Nuclear Society;* **50**: 581-582(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

The Central Research Laboratories (CRL) Division of Sargent Industries is now developing SAMSIN, a next-generation servo-manipulator. SAMSIN is an acronym for Servo-Actuated Manipulator Systems with Intelligent Networks. This paper discusses the objectives of this development and describes the key features of the servo-manipulator system. There are three main objectives in the SAMSIN development: adaptability, reliability, and maintainability. SAMSIN utilizes standard Sargent/CRL sealed master and slave manipulator arms as well as newly developed compact versions. The mechanical arms have more than 20 yr of successful performance in industrial applications such as hot cells, high vacuums, fuel pools, and explosives handling. The servo-actuator package is in a protective enclosure, which may be sealed in various ways from the remote environment. The force limiting characteristics of the servo-actuators extend motion tendon life. Protective bootings increase the reliability of the arms in an environment that is high in airborne contamination. These bootings also simplify the decontamination of the system. The modularity in construction permits quick removal and replacement of slave arms, wrist joints, tong fingers, and actuator packages for maintenance. SAMSIN utilizes readily available off-the-shelf actuator and control system components. Each manipulator motion uses the same actuator and control system components.

34534 **Remote process robotic demonstration.** Hagmann, D.B.; McNair, J.M. (GA Technologies, San Diego, CA). *Transactions of the American Nuclear Society;* **50**: 582-584(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

GA Technologies, Inc. (GA) has developed a robotic material handling for use in the demilitarization of obsolete munitions. The process involves cooling the munitions to cryogenic temperatures, fracturing the munition casings, and destroying the contents by placing the fractured munition pieces in a high-temperature furnace. This process uses robotics to perform three separate functions: (a) depalletizing and unpacking munitions, (b) moving munitions into and out of the cryogenic bath, and (c) loading munitions into the fracture machine. This paper describes the robotic munition handling demonstration results and application of this experience to future nuclear facility material handling operations.

34535 **Los Alamos upgrade in metallographic capabilities.** Ledbetter, J.M.; Dowler, K.E.; Cook, J.H. (Los Alamos National Lab., NM). *Transactions of the American Nuclear Society;* **50**: 586-587(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

The Los Alamos Wing 9 hot cell metallographic sample preparation and examination capability is being upgraded. The present capability to grind, polish, and etch samples from reactor fuels and materials has been in operation for 18 years. Upgraded capabilities in the sodium distillation unit and the grinding and polishing facilities and innovations in blister design for microstructural examinations are described in the paper.

34536 **Innovations in Los Alamos alpha box design.** Ledbetter, J.M.; Cook, J.H.; Dowler, K.E. (Los Alamos National Lab., NM). *Transactions of the American Nuclear Society;* 50: 587-588(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

Destructive examinations of irradiated fuel pins containing plutonium fuel must be performed in shielded hot cells with strict provisions for containment. Alpha boxes have been used in the Wing 9 hot cells at Los Alamos National Laboratory for more than 20 years. Recent modifications have been made to the alpha box supports, window sealing system, and intercell transfer systems, and new macroviewing and camera systems have been installed. These modifications and the reasons they were needed are briefly described.

34537 **Hot-cell design considerations for interfacing eddy-current systems.** Franklin, E.M.; Webb, J.P. (Argonne National Lab.-West, Idaho Falls, ID). *Transactions of the American Nuclear Society;* 50: 588-589(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

For the past several years, the Hot Fuel Examination Facility (HFEF) has conducted remote eddy-current examination of irradiated fuel elements. Considerable operating experience has been accrued interfacing eddy-current devices to hot cells. Recent modifications to the HFEF remote eddy-current inspection system have included absolute scanning probes permitting ferrite inspection and point-probe cladding defect examination. With each modification or new equipment installation, new operating difficulties are encountered. As a result, HFEF has identified several interfacing parameters that should be considered when installing or modifying eddy-current hot cell systems. These include impedance matching, system resonant frequency, and connecting feedthrough.

34538 **Robotic system for process sampling.** Dyches, G.M. (Savannah River Lab., Aiken, SC). *Transactions of the American Nuclear Society;* 50: 592-593(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

A robotic system has been developed to assist process sampling operators in installing and removing sample containers in one of the Savannah River Plant chemical radioisotope separations facilities. The system allows the operator to remotely perform sample handling operations that were previously performed in proximity to the process samplers, thus reducing radiation exposure and the potential for contamination. The robot is a custom-designed three-axis Cartesian geometry robot arm driven by three servomotors. The system is currently being evaluated in the production process. A program is under way to develop a more sophisticated robot that expands the functions of the existing version.

34539 **Update on the Hot Fuel Examination Facility complex.** Bacca, J.P. (Argonne National Lab.-Idaho, Idaho Falls). *Transactions of the American Nuclear Society;* 50: 601-603(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

The Hot Fuel Examination Facility (HFEF) complex comprises two hot cell facilities, HFEF/North and HFEF/South. At present, these facilities are used primarily for postirradiation handling, examination, and disposition of irradiation experiments from liquid-metal fast breeder reactor (LMFBR) fuels and materials surveillance and development programs, and from LMFBR reactor safety development programs. Capabilities for neutron tomography and remote wire-wrapping of irradiated LMFBR program fuel elements have recently been added to HFEF. Also, HFEF remote handling capabilities have been upgraded by the addition of seven heavy-duty Central Research Laboratory System 50 master slave manipulators, and by new glove box provisions for maintenance and repair of the System 50 manipulator slave ends. Bridge-mounted manipulators in the HFEF/North main and decontamination cells are being upgraded to 907-kg capacities from 340-kg capacities. HFEF will soon deepen the pit, located below the HFEF/North main cell, for the east neutron radiography station of the HFEF/North Neutron Radiography (NRAD) facility. The deepened pit will accommodate irradiated components up to 5.2 m long, an increase of 2.3 m over the present capability.

34540 **Hot cell verification facility update.** Titzler, P.A.; Moffett, S.D.; Lerch, R.E. (Westinghouse Hanford Co., Richland, WA). *Transactions of the American Nuclear Society;* 50: 603-605(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

The Hot Cell Verification Facility (HCVF) is operated by the Westinghouse Hanford Co. in the 300 Area of Hanford. The HCVF provides a prototype hot cell mock-up for use in checking equipment and operations for functional and remote operation. The facility can also be used for hands-on training of operating personnel prior to actual hot operation of the equipment. A broad spectrum of testing and development functions is performed in HCVF, including: equipment operability testing, maintainability and compatibility testing, system integration, and remote maintenance capability testing. An updated description of the HCVF is presented in this paper.

34541 **Electric air filtration movie.** Bergman, W.; Jaeger, R. (Lawrence Livermore National Lab., CA). pp 593-596 of Aerosols. Liu; Pui; Fissan (eds.). New York, NY; Elsevier Science Publishing Co., Inc. (1984). Contract W-7405-ENG-48.

The use of electrostatics to improve the performance of conventional air filters has gained considerable attention in recent years. This interest is due to the higher efficiency and reduced pressure drop of electrically enhanced filters compared to conventional fibrous filters. This 30-minute movie presents a state of the art review of electric air filters in the United States with major illustrations provided by the research and development program at the Lawrence Livermore National Laboratory sponsored by the Department of Energy. The electric air filters described in this movie are mechanical air filters to which electrical forces have been added.

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REFER ALSO TO CITATION(S) 33749, 34374, 34640

34542 **(AD-A—163529/1/XAB) Reverse-wave suppressor mirror effects on c-w h-f unstable ring laser performance.** Bernard, J.M.; Chodzko, R.A. (Aerospace Corp., El Segundo, CA (USA). Aerophysics Lab.). 30 Sep 1985. 34p. (TR—0084A(5764)-1). NTIS, PC A03/MF A01.

The effect of a reverse-wave suppressor (RWS) mirror on the performance of a c-w r-f unstable ring laser was measured in terms of forward/reverse-wave power ratio (R) and forward-wave beam quality. It was found that a well-aligned RWS mirror gave the best suppression R = approx. 100 and diffraction-limited beam quality. Resonator performance degraded rapidly with misalignment of the RWS mirror: a 200-microrad tilt reduced R to 2.5 and the beam quality by a factor of 2. The forward-wave near-field pattern showed distinct fringes as the RWS mirror was misaligned, suggesting that a higher-order mode was causing the beam quality to degrade. A novel technique was developed to reduce the alignment sensitivity of the RWS mirror. By use of a distorted relay mirror, an aberrated (approx. = 2 lambda) reverse wave was fed back into the ring. The aberrated reverse-wave feedback greatly reduced the sensitivity of resonator performance to RWS mirror tilt. Diffraction-limited beam quality and good suppression (R = approx. 20) was observed over a tilt range of 600 microrad. It is

postulated that the aberrated RWS mirror provides sufficient feedback to suppress the reverse wave over a wide angular range, yet not enough to produce higher-order transverse modes in the forward wave.

34543 **(AD-A—163774/3/XAB) Pulsations of semiconductor lasers with a proton-bombarded segment: well-developed pulsations.** (Massachusetts Inst. of Tech., Cambridge (USA). Research Lab. of Electronics). Jun 1985. 7p. NTIS, PC A02/MF A01.

An analytic theory is presented of well-developed pulsations in semiconductor lasers with a proton-bombarded segment. A rate equation model is used with the proton bombarded region modeled as a fast saturable absorber. A closed form solution was obtained for the pulse shape, width, and energy, as well as the pulsation rate. The pulses can be as short as the diode roundtrip time (10 ps). A simple pulsation condition is derived; it agrees with the previously determined small signal instability criterion. Pulsation does not require absorber cross section larger than gain cross section.

34544 **(AD-A—163901/2/XAB) Studies on radiative collisional and ultraviolet lasers. Final report, 1 January 1983-31 December 1985.** Harris, S.E.; Young, J.F. (Stanford Univ., CA (USA). Edward L. Ginzton Lab.). Nov 1985. 24p. NTIS, PC A02/MF A01.

Significant accomplishments of this program include: the first microwave pumping of an excimer laser; the first use of pulsed hollow-cathode technology to produce substantial quantities of core-excited metastable atoms; the use of these metastable atoms to delineate a partial Grotrian diagram for core-excited Na; the proposal of the concept of quasi-metastable quartet levels and the experimental verification of their importance in the column I metals; and the proposal for short-wavelength systems based on super Coster-Kronig transitions. Abstracts: Laser Techniques for Extreme Ultraviolet Spectroscopy; Active Mode Looking of a Microwave-Pumped XeCl Laser; Measurement of Lithium and Sodium Metastable Quartet Atoms in a Hollow-Cathode Discharge; Quasi-Metastable Quartet Levels in Alkalilike Atoms and Ions; Grotrian Diagram of the Quartet System of Na I; Emission at 1091 A in Neutral Core-Excited Cs; Metastability in the Extreme Ultraviolet: Lasers and Spectroscopy; Laser Spectroscopy of Na I Quartets; X-Ray Excitation of Energetic Metastable Levels in Atoms and Ions; Proposal for an Extreme-Ultraviolet Selective Autoionization Laser in Zn III; XUV Emission Spectra of Core-Excited Levels in Sodium and Magnesium; Quasi-Metastable Energy Levels and Applications; Shake-up as a Mechanism for VUV Lasers; and Emission Spectra of Quasi-Metastable Levels of Alkali Atoms.

34545 **(AD-A—163913/7/XAB) Effect of He^3 on CO_2 laser power.** Stein, D.T. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 1 Jan 1986. 3p. (JA—57991). NTIS, PC A02/MF A01.

Substitution of He^3 for normal helium in a sealed-off conventional CO_2 laser resulted in power output increases as high as 14%. No such effect was observed in a narrow-bore waveguide laser, indicating that the observed improvements were due to more efficient heat conduction to the tube wall.

34546 **(AD-A—164339/4/XAB) Effects of rectangular boundaries in linearly polarized wiggler free-electron laser. Technical report, 1 October 1982-30 September 1983.** Elias, L.R. (California Univ., Santa Barbara (USA). Quantum Inst.). 1983. 10p. (QIFEL—022/83). NTIS, PC A02/MF A01.

An integral form for the solution of Maxwell's equations coupled with the pendulum equation is used to present a three-dimensional theory for a single-pass free-electron-laser amplifier. The method is extended to include the effects of perfectly conducting rectangular boundaries. An expansion of the radiated field is also derived in terms of cavity modes. The expansion is used to compute the power gain into different modes. It is shown that few lowest-order resonator modes are excited, and the feasibility of a self-consistent multimode theory done in this formulation is discussed.

34547 **(AD-A—164366/7/XAB) Radiation measurements for UCSB FEL. Technical report, 1 October 1982-30 September 1983.** Elias, L.R.; Ramian, J. (California Univ., Santa Barbara (USA). Quantum Inst.). 1983. 7p. (QIFEL—021/83). NTIS, PC A02/MF A01.

A calibrated He-cooled Ge bolometer will be used to measure 2nW average spontaneous power at 380-um wavelength; the spectral analysis will use a Fabry-Perot interferometer. The more-powerful laser output will be analyzed by a heterodyne spectrometer.

34548 **(AD-A—164376/6/XAB) Design of the UCSB FEL (free electron laser) electron beam system. Technical report, 14 January 1982-13 January 1983.** Elias, L.R. (California Univ., Santa Barbara (USA). Quantum Inst.). 1982. 31p. (TR—11). NTIS, PC A03/MF A01.

It's principal objective is to demonstrate the operation of electrostatic accelerator free-electron lasers in 1) the far-infrared radiation submillimeter region at high average power and high overall efficiency using a single-stage FEL and 2) the visible IR region with modest power and modest overall efficiency using a two-stage FEL. An important feature of the FEL is the recovery of the spent electron beam. Both 1) the average laser power and 2) the overall efficiency of the FEL increase with increased electron beam collection efficiency. Optimum laser performance can be achieved with this device provided only a small fraction of the total electric charge stored in the beam is lost while transporting it through the system. Realization of this low charge loss condition can be achieved only if a very-high-quality electron beam can be produced and maintained throughout the electron accelerator and transport system. It is for this reason that a considerable amount of FEL project time has been dedicated to the design of a high-quality electron-beam source and an electron transport and recovery system having a minimum amount of optical aberrations.

34549 **(AD-A—164444/2/XAB) Coherent Leinard-Wiechert fields produced by FELs (free-electron laser). Technical report, 14 January 1981-13 January 1982.** Elias, L.R. (California Univ., Santa Barbara (USA). Quantum Inst.). Dec 1981. 5p. (TR—9). NTIS, PC A02/MF A01.

Results are presented of a three-dimensional numerical analysis of the radiation fields produced in a free-electron laser. The method used here to obtain the spatial and temporal behavior of the radiated fields is based on the coherent superposition of the radiated fields is based on the coherent superposition of the exact Lienard-Wiechert fields produced by each electron in the beam. Interference effects are responsible for the narrow angular radiation patterns obtained and for the high degree of monochromaticity of the radiated fields.

34550 **(AD-A—164455/8/XAB) Small-signal gain of a FEL (free electron laser) in a resonator Gaussian mode. Technical report, 1 October 1983-30 September 1984.** (California Univ., Santa Barbara (USA). Quantum Inst.). 1984. 17p. (QIFEL—027/84). NTIS, PC A02/MF A01.

An analytical expression is presented for the small signal gain of a free electron laser (FEL) in the presence of a Gaussian mode. The one-dimensional Vlasov equation is used to describe the electron beam evolution. The perturbative result is valid for small values of the parameter q(length of the undulator L divided by the Rayleigh range z/sub R/.

34551 **(AD-A—164471/5/XAB) Electrostatic-accelerator free-electron lasers. Technical report, 1 October 1982-30 September 1983.** Elias, L.R. (California Univ., Santa Barbara (USA). Quantum Inst.). 1983. 19p. (QIFEL—004/80). NTIS, PC A02/MF A01.

The present paper addresses the problem of increasing the power and efficiency of free electron lasers from a point of view fundamentally different from any known schemes. The schemes discussed here are based on the utilization of electron lasers for commercial or laboratory applications. Three schemes discussed are: a) short-pulse operation with no energy recovery, b) c-w single-stage operation with energy recovery, and c) c-w two-stage operation

with energy recovery. Also, a review is made of the electron beam quality required by the FEL.

34552 (AD-A—164499/6/XAB) Energy extraction from the electron beam in a free-electron laser resonator Gaussian mode. Technical report, 1 October 1981-30 September 1982. Elias, L.R. (California Univ., Santa Barbara (USA). Quantum Inst.). 1983. 8p. (QIFEL—026/83). NTIS, PC A02/MF A01.

Preliminary analytical results are prsented of enerby extraction and gain of a free electron laser (FEL) in the presence of a TEMoo Gaussian mode. The result is applicable to all values of the paramter q (length of the undulator L divided gy the Rayleigh range zRI) in second order of the input field. Simple analytical approximate expressions are prsented also for the small single gain valid for q 2.8.

34553 (AD-A—164513/4/XAB) Free-electron lasers. Technical report, 1 October 1983-30 September 1984. Elias, L.R. (California Univ., Santa Barbara (USA). Quantum Inst.). 1984. 9p. (QIFEL—030/84). NTIS, PC A02/MF A01.

The operation of a free electron laser (FEL) is based on the amplification of electromagnetic radiation by relativistic electrons moving throught a periodic electromagnetic structure. A typical system contains the following three basic components: (a) a monochromatic electron beam, (b) a periodic static magnetic field generated by either an array of permanent magnets (wiggler or undulator) oriented with alternating magnetic field polarity or by a periodic arrangement of current-carrying conductors, and (c) and electromagnetic resonator.

34554 (LA-UR—86-1525) Long-pulse excimer lasers for materials processing and medical applications. Sze, R.C. (Los Alamos National Lab., NM (USA)). 1986. Contract W-7405-ENG-36. 17p. (CONF-8605110—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011267.

From OPTO '86 conference; Paris, France (13 May 1986).

Present day commercial excimer lasers with the exception of the Helionetics device are inherently short pulse ultraviolet sources. The pulses are short due to the inherent instability of the avalanche discharge with electronegative elements in the gas mix. The utilization of an initial fast voltage risetime allows one to overcome this difficulty and a number of long-pulse lasers are built using this technique. While the initial lasers of this form used a series rail-gap to achieve the fast voltage risetime, subsequent schemes using magnetic pulse compression and a fast prepulse have greatly improved the viability of the technique as a commercial device. Presently, however, these devices are generally rather bulky. This report discusses a passive stabilization technique that not only allows long pulse laser operation, but allows for a much slower charging circuit as well as a factor of 10 gain in pulse repetition rate per given gas flow compared with more conventional excimer laser systems. The slower charging circuit greatly eases the stress on the pulse power components such as thyratrons and capacitors and should be an important factor contributing to dependable industrial excimer laser systems. The gain of a factor of 10 in pulse repetition rate per unit gas flow results in extremely high pulse repetition rate laser systems in a very compact package; such lasers should find a place in a number of industrial and medical applications. 10 figs.

34555 (LA-UR—86-1547) Angular dependence of multilayer-reflector damage thresholds. Newnam, B.E.; Foltyn, S.R.; Gill, D.H.; Jolin, L.J. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 27p. (CONF-8410186—6). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86011265.

From Symposium on optical materials for high power lasers; Boulder, CO, USA (15 Oct 1984).

The damage resistance of HfO_2/SiO_2 multilayer dielectric reflectors was measured as a function of angle of incidence with 351-nm XeF-laser irradiation. The laser produced nominal 10-ns pulses at a repetition rate of 35 pps. A series of reflectors designed for 0°, 30°, 45°, 60°, 75°, and 85° was tested with an S-plane polarized beam. To account for variations in the separate coating depositions, some of the coating designs were tested at two angles of incidence. At large angles of incidence, we did not observe the anticipated large increases in damage thresholds predicted theoretically on the basis of spatial dilution ($1/\cos\theta$) of the intensity at the reflector surface and standing-wave electric fields. For example, the threshold for a reflector designed and tested at 85° was only a factor of 2.5 larger than that of normal-incidence reflectors tested at 0°. Several possible mechanisms to explain this discrepancy were considered. 11 refs.

34556 (LA-UR—86-1682) Overtone production of soft x-rays with free-electron lasers. Schmitt, M.J.; Elliott, C.J.; Lee, K.; McVey, B.D. (Los Alamos National Lab., NM (USA)). 1986. Contract W-7405-ENG-36. 8p. (CONF-860316—8). NTIS, PC A02/MF A01; GPO Dep. File Number DE86011248.

From Topical meeting on short wavelength coherent radiation; Monterey, CA, USA (24 Mar 1986).

Two one-dimensional free-electron laser codes have recently been written that include harmonic generation. A comparison of the results of these codes show that a self-consistent treatment of the harmonic interaction is not required in the presence of a strong fundamental field. Use of these codes to predict the effects of emittance on harmonic production have been conducted. The effects of wiggler-field amplitude fluctuations and odd-harmonic wiggler-field components on the harmonic-radiation production are also discussed.

34557 (PB—86-154275/XAB) Influence of feedback intensity on longitudinal mode properties and optical noise in index-guided semiconductor lasers. Acket, G.A.; Lenstra, D.; den Boef, A.J.; Verbeek, B.H. (Technische Hogeschool Delft (Netherlands). Afdeling Elektrotechniek). Feb 1984. 29p. (REPT—1984-04). NTIS, PC A03/MF A01.

Theory and experiments on optical feedback effects in index-guided single-mode semiconductor lasers are presented. Evidence is found for the existence of a characteristic parameter C, which indicates the relative strength of the optical feedback. Near the transition (C about = 1.0) from low to high feedback, the feedback-induced noise shows a maximum. At higher feedback, hysteresis and instabilities are dominant, whereas the feedback-induced noise is low again.

34558 (PPPL—2326) Radiation cooling and gain calculation for C VI 182 A line in C/Se plasma. Nam, C.H.; Valeo, E.; Suckewer, S.; Feldman, U. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Apr 1986. Contract AC02-76CH03073. 31p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86011171.

A model is developed which is capable of describing the evolution of gain resulting from both rapid radiative and expansion cooling of a recombining, freely expanding plasma. It is demonstrated for the particular case of a carbon/selenium plasma that the cooling rate which leads to optimal gain can be achieved by adjusting the admixture of an efficiently radiating material (selenium) in the gain medium (carbon). Comparison is made to a recent observation of gain in a recent NRL/Rochester experiment with carbon/selenium plasma for the $n = 3 \rightarrow 2$ transition in C VI occurring at 182 A. The predicted maximum gain is $\sim 10\ cm^{-1}$, as compared to observation of 2 to 3 cm^{-1}.

34559 Imperfect bifurcation with a slowly-varying control parameter. Erneux, T.; Mandel, P. (Dept. of Engineering Sciences and Applied Mathematics, The Technological Inst., Northwestern Univ., Evanston, IL 60201). *SIAM Journal on Applied Mathemadics;* **46**: No. 1, vp(Feb 1986). Contract AC02-78ER04650.

The authors consider a general class of imperfect bifurcation problems described by the following first order nonlinear differential equation: λ/sub T/ = Ky/sup RHO/ + λ(t)y+δ, where k = 1 or -1 and p = 2 or 3 are fixed quantities. The solution depends on the values of the "imperfection" parameter $\delta(0 < \delta << 1)$ and the time-dependent control parameter $\lambda(t) = \lambda_0 + \epsilon t$ ($\lambda_0 < 0$ and $0 < \epsilon << 1$). If $\delta = \epsilon = 0$, this equation admits at $\lambda = 0$ a bifurcation from the basic state y = 0 to nonzero steady states. In the first part of the paper, they analyze the perturbation of the bifurcation solu-

tions produced both by the small imperfection (δ not equal to 0). We show that $\lambda = 0$ does not correspond to the transition between the two branches of slowly-varying steady states. This transition appears at a larger value of $\lambda = \lambda_1$. Provided that δ is sufficiently small compared to ϵ, λ_1 is an 0(1) quantity which only depends on λ_0 i.e., the initial position of λ(t). The analysis is motivated by problems appearing in laser physics. In the second part of the paper, they show how the semiclassical equations for the simple laser and the laser with a saturable absorber can be reduced to this simple first-order nonlinear equation. We then discuss the practical interests of our results.

34560 **Optical injection locking of laser diode arrays.** Goldberg, L.; Taylor, H.F.; Weller, J.F. (to Dept. of the Navy, Washington, DC). US Patent Application 6-795,796. 7 Nov 1985. 19p. NTIS, PC A02/MF A01.

Injection locking of a laser array by a single master laser is achieved. A single-lobe far-field pattern and a single-mode emission spectrum in the output of the laser array results.

34561 **Reflex ring laser amplifier system.** Summers, M.A. (to Dept. of Energy). US Patent 4,549,144. 22 Oct 1985. Filed date 31 Aug 1983. vp.

PAT-APPL-528285.

A laser pulse is injected into an unstable ring resonator-amplifier structure. Inside this resonator the laser pulse is amplified, spatially filtered and magnified. The laser pulse is recirculated in the resonator, being amplified, filtered and magnified on each pass. The magnification is chosen so that the beam passes through the amplifier in concentric non-overlapping regions similar to a single pass MOPA. After a number of passes around the ring resonator the laser pulse is spatially large enough to exit the ring resonator system by passing around an output mirror.

34562 **Laser beam monitoring system.** Weil, B. S.; Wetherington Jr., G. R. (to The United States of America as represented by the United States Department of Energy). US Patent 4,544,839. 1 Oct 1985. Filed date 16 Dec 1982. vp.

PAT-APPL-450305.

Laser beam monitoring systems include laser-transparent plates set at an angle to the laser beam passing therethrough and light sensor for detecting light reflected from an object on which the laser beam impinges.

34563 **Optical pumping with a frequency-modulated multimode dye laser.** Giberson, K.W.; Dunning, F.B. (Dept. of Space Physics and Astronomy and the Rice Quantum Inst., Rice Univ., Houston, TX 77251). pp 356-359 of Lasers '84. McLean, VA; STS Press (1984). (CONF-8411153—).

From International conference on lasers '84; San Francisco, CA, USA (26 Nov 1984).

The authors demonstrate that very efficient, stable optical pumping of a collimated atomic beam can be achieved using a low-power, frequency-modulated multimode dye laser.

34564 **Laser technologies for laser accelerators.** Lowenthal, D.D.; Taussig, R.T.; Kushner, M.J.; Slater, J.M. (Spectra Tech., Inc., 2755 Northup Way, Bellevue, WA 98004). pp 484-492 of Lasers '84. McLean, VA; STS Press (1984). (CONF-8411153—).

From International conference on lasers '84; San Francisco, CA, USA (26 Nov 1984).

This paper reports several aspects of work to evaluate the laser technology available for laser accelerator applications. Included is a method for determining the laser system requirements based on the desired accelerator luminosity and electron beam constraints imposed by brightness, emittance, beam disruption and "beamstrahlung". Scaling for the laser parameters such as average power, energy per pulse, rep rate, pulse length, and peak power are derived starting from the desired electron final energy, and the luminosity. It is found that the electron beam bunch diameter is a critical parameter that must be made small ($<< 1\ \mu$) if the total laser power required is to be minimized. Further, reducing the bunch diameter also reduces the total energy per pulse. The advantage of lower laser power comes at the expense of higher repetition rate to maintain a given luminosity. An interesting result is that the luminosity does not scale as the laser average power, but instead as P/ sub AV//(E/sub L/)/sup 1/4/ where E/sub L/ is the laser energy per pulse.

34565 **High power, high repetition rate, line narrowed alexandrite laser.** Rapoport, W.R.; Sam, R.C.; Shand, M.L. (Military Laser Products, Allied Corp., 31717 La Tienda Drive, Westlake Village, CA 91362). pp 552-554 of Lasers '84. McLean, VA; STS Press (1984). (CONF-8411153—).

From International conference on lasers '84; San Francisco, CA, USA (26 Nov 1984).

An alexandrite laser has been in operation at 240 Hz, 400 mJ/pulse, near 790 nm with 0.005 nm linewidth for over eleven hours of sustained operation.

34566 **New harmonic materials: Index engineering.** Eimer, D. (Nonlinear Optical Materials Group, Lawrence Livermore National Lab., Livermore, CA 94550). pp 555-556 of Lasers '84. McLean, VA; STS Press (1984). (CONF-8411153—). Contract W-7405-ENG-48.

From International conference on lasers '84; San Francisco, CA, USA (26 Nov 1984).

The goal of advanced nonlinear materials research is to develop the capability of matching material parameters to a particular desired application. Although it is conceivable that enough materials can be found to cover all applications, this possibility is considered unlikely. Rather, the goal will most likely be achieved with (1) a suite of pure materials sparsely covering a broad range of operating conditions, and (2) the skill to engineer or fine-tune a nonlinear material to a specific application. Survey work to develop a suite of base materials is in progress, and we are developing the technique of index engineering. This paper describes its application to the KDP series of homologs. Index engineering is a method of adjusting the refractive indices of a material to abtain non-critical phase-matching over a range of wavelengths. The index is adjusted either by doping the crystal or by making solid solutions of structurally similar crystals. Thus, the lattice constants and the UV absorption edge are affected, changing both the birefringence and the wavelength dispersion. By an adroit choice of materials, some decoupling between the changes in the birefringence and the dispersion can be arranged.

34567 **Thin-thick quadrature frequency conversion.** Eimeri, D. (Nonlinear Optical Materials Group, Lawrence Livermore National Lab., Livermore, CA 94550). pp 557-559 of Lasers '84. McLean, VA; STS Press (1984). (CONF-8411153—). Contract W-7405-ENG-48.

From International conference on lasers '84; San Francisco, CA, USA (26 Nov 1984).

The quadrature conversion scheme is a method of generating the second harmonic. The scheme, which uses two crystals in series, has several advantages over single-crystal or other two crystal schemes. The most important is that it is capable of high conversion efficiency over a large dynamic range of drive intensity and detuning angle.

34568 **Rapid growth of potassium dihydrogen phosphate crystals.** Cooper, J.F.; Singleton, M.F. (Inertial Confinement Fusion Program, Lawrence Livermore National Lab., Livermore, CA 94550). pp 567-574 of Lasers '84. McLean, VA; STS Press (1984). (CONF-8411153—). Contract W-7405-ENG-48.

From International conference on lasers '84; San Francisco, CA, USA (26 Nov 1984).

The authors report the development of a process for high rate (15 mm/d) growth of potassium dihydrogen phosphate single crystals. Correlations for mass transport by convective diffusion (to cones or disks under axially-impinging flow) are applied to published rate data on 3-mm KDP crystals to derive a semi-empirical kinetic equation for (101) growth rate. Material properties, transport, and kinetic equations are then solved numerically to predict the dependence of growth rate on temperature, supersaturation, and the ratio of flow rate to a crystal dimension. The model is experimentally verified for 20-25 mm crystals grown at rates of 5-25 mm/d using a turbine to enhance solute flux to the pyramidal faces. They conclude that high growth rate of large cyrstals is possible

and scales according to the ratio of characteristic velocity to crystal dimension.

34569 **Recent results of the Los Alamos free-electron laser oscillator experiment.** Sheffield, R.L.; Warren, R.W.; Newham, B.E.; Stein, W.E.; Goldstein, J.C.; Lynch, M.T. (Los Alamos National Lab., Los Alamos, NM 87545). pp 648-656 of Lasers '84. McLean, VA; STS Press (1984). (CONF-8411153—).

From International conference on lasers '84; San Francisco, CA, USA (26 Nov 1984).

Since the last Lasers '83 Conference, significant progress has been made on the Los Alamos free-electron laser (FEL). Although the previously reported results were in agreement with theory, the data were plagued by gain fluctuations, and no spectral measurements had been obtained. Since then, the source of the fluctuations has been analyzed and substantially reduced. Also, the optical power and spectra dependence on beam emittance, alignment, cavity length, energy spread, and current were systematically studied. This paper reports on the results obtained with a uniform-period wiggler.

4204 Heat Transfer And Fluid Flow

REFER ALSO TO CITATION(S) 33984, 33993, 34008, 34010, 34056, 34092, 34093, 34097, 34197, 34604

34570 **(CONF-860712—1) General theory for dynamic instability of tube bundles in crossflow.** Chen, S.S. (Argonne National Lab., IL (USA)). 1985. Contract W-31-109-ENG-38. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86003066.

From International conference on vibration problems in engineering; Xian, China (17 Jul 1986).

A general theory of fluidelastic instability for a tube array in crossflow is presented. Various techniques to obtain the motion-dependent fluid-force coefficients are discussed and the general instability characteristics are summarized. The theory is also used to evaluate the results of other mathematical models for crossflow-induced instability. 10 refs.

34571 **(DOE/CE/15225—T2) Sno flow development. Progress report, January 1-March 31, 1986.** Fleming, G.L. (Krause Flow Corp., Hutchinson, KS (USA)). 1986. Contract FG01-85CE15225. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86009739.

Information is presented on the design and testing of a discharge system for the removal of water from snow. The testing revealed the need for the unit discharge rate to be adjustable to meet the various conditions of both water temperature and incoming gallonage of water. The redesign for discharge adjustment also allowed for matching the unit to storm sewer capacity. Five individual test locations are cited; they are: Hopkins, Minnesota; Portsmouth, New Hampshire; Lexington, Nebraska; Albany, New York; and Madison, Wisconsin. (JDB)

34572 **(DOE/NE—0066) Sensors and nuclear power. Report by the Technology Transfer Sensors Task Team.** (USDOE Assistant Secretary for Nuclear Energy, Washington, DC). Jun 1985. 143p. NTIS, PC A07/MF A01; GPO Dep. File Number DE86011405.

The existing sensor systems for the basic process parameters in nuclear power plant operation have limitations with respect to accuracy, ease of maintenance and signal processing. These limitations comprise the economy of nuclear power generation. To reduce the costs and improve performance of nuclear power plant fabrication, operation, maintenance and repair we need to advance the sensor technology being applied in the nuclear industry. The economic viability and public acceptance of nuclear power will depend on how well we direct and apply technological advances to the industry. This report was prepared by a team with members representing a wide range of the nuclear industry embracing the university programs, national laboratories, architect engineers and reactor manufacturers. An intensive effort was made to survey current sensor technology, evaluate future trends and determine development needs. This included literature surveys, visits with utilities, universities, laboratories and organizations outside the nuclear industry. Several conferences were attended to take advantage of the access to experts in selected topics and to obtain opinions. Numerous telephone contacts and exchanges by mail supplemented the above efforts. Finally, the broad technical depth of the team members provided the basis for the stimulating working sessions during which this report was organized and drafted.

34573 **(LA-UR—86-1707) Detailed transient model of a liquid-metal heat pipe.** Costello, F.A.; Montague, A.F.; Merrigan, M.A. (Costello (F.A.), Inc., Herndon, VA (USA); Los Alamos National Lab., NM (USA); General Electric Co., Philadelphia, PA (USA)). 1986. Contract W-7405-ENG-36. 6p. (CONF-860612—7). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011212.

From 4. AIAA/ASME thermophysics and heat transfer conference; Boston, MA, USA (2 Jun 1986).

A detailed transient model of a liquid-metal heat pipe is being developed. The model includes start from the frozen state, with provision for free-molecule flow, and proceeds through the steady-state operating conditions. The KACHINA method has been selected for simulating the compressible flow in the core; the SIMPLER method, for simulating the liquid flow in the wicks and grooves. The computational methods have been demonstrated on a Compaq Deskpro II. The FORTRAN cove is currently being converted to the IBM 3033 and Cray I. Based on the ratio of Cray to Compaq speeds, the Cray computation times are estimated to be 30 minutes per hour simulated.

34574 **(SAND—85-2797C) Continuum theories for suspensions.** Nunziato, J.W.; Passman, S.L.; Givler, R.C.; McTigue, D.F.; Brady, J.F. (Sandia National Labs., Albuquerque, NM (USA); California Inst. of Tech., Pasadena (USA). Dept. of Chemical Engineering). 1986. Contract AC04-76DP00789. 8p. (CONF-860625—2). NTIS, PC A02. File Number DE86010988.

From American Society of Civil Engineers meeting on advancements in aerodynamics, fluid mechanics and hydraulics; Minneapolis, MN, USA (3 Jun 1986).

The balance equations that describe suspensions as multiphase mixtures are presented. The strategy for the development of constitutive equations is based on the properties of the individual phases and on single- or multiple-particle analyses. The approach is illustrated in the case of a dilute suspension. Approaches to the construction of models for concentrated suspensions are also discussed.

34575 **(SAND—86-8217) Nonreacting turbulent mixing flows: a literature survey and data base.** Schefer, R.W.; Johnston, S.C.; Dibble, R.W.; Gouldin, F.C.; Kollmann, W. (Sandia National Labs., Livermore, CA (USA); Cornell Univ., Ithaca, NY (USA); California Univ., Davis (USA)). Apr 1986. Contract AC04-76DR00789. 222p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE86010864.

The objective of this report is to provide a comprehensive review of available data on turbulent nonreacting flows. This review is limited to parabolic, stationary shear flows with well defined boundary conditions; these flows have many of the characteristics found in combustion devices and are typical of laboratory flames for which model evaluation data are most likely to be available. This report is an outgrowth of a more extensive study conducted under the direction of the Air Force Office of Scientific Research. A bound volume containing the results of that study will be available in the near future. Our purpose in compiling the data presented here is to provide a more comprehensive tabulation of nonreacting flow measurements than was possible to include in the Air Force report. 97 refs., 23 figs., 184 tabs.

34576 **Bifurcation with memory.** Olmstead, W.E.; Davis, S.H.; Rosenblat, S.; Kath, W.L. (Dept. of Engineering Sciences and Applied Mathematics, Northwestern Univ., Evanston, IL 60201). *SIAM Journal on Applied Mathemadics;* **46**: No. 2, vp(Apr 1986). Contract AC02-78ER04650.

A model equation containing a memory integral is posed. The extent of the memory, the relaxation time λ, controls the bifur-

cation behavior as the control parameter R is increased. Small (large) λ gives steady (periodic) bifurcation. There is a double eigenvalue at $\lambda = \lambda_1$, separating purely steady ($\lambda < \lambda_1$) from combined steady/T-periodic ($\lambda > \lambda_1$) states with $T \to \infty$ as $\lambda \to \lambda^+_1$. Analysis leads to the co-existence of stable steady/periodic states and as R is increased, the periodic states give way to the steady states. Numerical solutions show that this behavior persists away from $\lambda = \lambda_1$.

34577 **Modified sedimentation-dispersion model for solids in a three-phase slurry column.** Smith, D.N.; Ruether, J.A.; Shah, Y.T.; Badgujar, M.N. (Pittsburgh Energy Technology Center, U.S. Dept. of Energy, Pittsburgh, PA 15236). *A.I.Ch.E. Journal (New York);* **32**: No. 3, vp(Mar 1986).

Solids distribution data for a three-phase, batch-fluidized slurry bubble column (SBC) are presented, using air as the gas phase, pure liquids and solutions as the liquid phase, and glass beads and carborundum catalyst powder as the solid phase. Solids distribution data for the three-phase SBC operated in a continuous mode of operation are also presented, using nitrogen as the gas phase, water as the liquid phase, and glass beads as the solid phase. A new model to provide a reasonable approach to predict solids concentration distributions for systems containing polydispersed solids is presented. The model is a modification of standard sedimentation-dispersion model published earlier. Empirical correlations for prediction of hindered settling velocity and solids dispersion coefficient for systems containing polydispersed solids are presented. A new method of evaluating critical gas velocity (CGV) from concentrations of the sample withdrawn at the same port of the SBC is presented. Also presented is a new mapping for CGV which separates the two regimes in the SBC, namely, incomplete fluidization and complete fluidization.

34578 **A numerical study of heat transfer in turbulent shear flow.** Circelli, B.R.; McLaughlin, J.B. (Dept. of Chemical Engineering, Clarkson Univ., Potsdam, NY 13676). *Numerical Heat Transfer;* **9**: No. 3, vp(1986). Contract AC02-82ER12033.

Results are presented for the heat flux and the intensity of temperature fluctuations, obtained by solving a modification of the forced-convection equation in which a mixing length profile is imposed on the spanwise and longitudinal average of the temperature field for points lying outside the wall region. The results for steady turbulent flow are shown to be in reasonably good agreement with the available experimental data. Results for unsteady turbulent flow, which indicate that the heat flux exhibits a strong phase dependence, are also given.

34579 **Quenching of hot vertical rods by top rewetting.** Khadem, M.; Seban, R.A. (Systems Control Inc., Palo Alto, CA). *Transactions of the American Nuclear Society;* **50**: 628-630(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

Cooling of a very hot surface by a falling liquid film is an important subject in nuclear safety applications. It is known that the quenched front velocity depends on coolant subcooling, hot surface temperature, coolant flow rate, and physical characteristics of the surface. Quench velocities have been measured on single vertical rods, and they can be correlated approximately on bases similar but not identical to existing correlations. For given operating conditions, they are similar to but somewhat lower than previous results. For combinations of two and three rods, the quench velocities were within +/-20% of those obtained with a single rod under the same operating conditions. Boiling curves obtained from the temperature histories indicated no typical nucleate boiling region, but rather a constant heat transfer coefficient. Maximum heat fluxes were like those associated with saturated pool boiling.

34580 **Asymmetric Graetz problem in channel flow.** Edwards, V.; Newman, J. (Univ. of California, Berkeley). *International Journal of Heat and Mass Transfer;* **28**: No. 2, 503-505(1985). Contract AC03-76SF00098.

The problem of mass transfer to fluids in laminar flow in ducts appears in many engineering applications. This problem has been solved for some special cases but the case of a flat duct, or channel, where the surface-concentration boundary conditions are arbitrary and may differ on the two channel walls is considered. This problem is of interest when the channel gap is thinner than the diffusion-boundary-layer thickness. In such cases, the fluxes at the two channel walls are not independent. Since the detailed concentration profile within the flowing fluid is generally not needed, the distribution of flux along the channel walls is emphasized. Given this flux distribution, the average concentration at the exit may be calculated by performing an overall material balance.

34581 **Disassembly of isochorically heated liquids.** Blink, J.A.; Hoover, W.G. (Lawrence Livermore National Lab., CA, USA). pp 93-100 of Liquid metal engineering and technology. 3 Vols. Proceedings of the 3. international conference held in Oxford on 9-13 April 1984. Vol. 2. London, England; British Nuclear Energy Society (1984). (CONF-840411—).

From 3. meeting on liquid metal in energy applications; Oxford, UK (9 Apr 1984).

In several inertial confinement fusion reactor concepts, the fusion neutrons will be suddenly deposited into liquid metals having free surfaces within the vacuum chamber. The neutron energy deposition will be so fast that the liquid will have little opportunity to expand during the deposition time; hence, the deposition can be considered to be at constant volume, or isochoric. However, the pressure rises to levels that can cause the liquid metals to break into fragments. Fragmentation of liquid metals inside ICF reactor vessels has two impacts on reactor design. First, the fragments eventually impact on the structure, causing a pressure load; the velocity and pressure load can be calculated from continuum mechanics computer codes. Second, the fragment size determines the liquid surface area available to interact thermally with superheated gases or plasma produced by the absorption of the short-ranged fusion x-rays and debris. Three hydrodynamic models for the fragmentation mechanism are reviewed. The first requires balancing of the internal pressure by the surface tension. The second balances the dynamic pressure of an expanding drop (after pressure relief) by the surface tension. The third model finds the fragment size for which the surface energy plus the local dilatational kinetic energy is minimized. Further studies to extend the molecular dynamics method are planned.

34582 **Time required to reach fully developed flow in pulsed supersonic free jets.** Saenger, K.L.; Fenn, J.B. (Massachusetts Institute of Technology, Cambridge). *Journal of Chemical Physics;* **79**: No. 12, 6043-6045(15 Dec 1983). Contract FG01-78ET11384.

A new and simple model is presented for estimating the minimum pulse duration (valve open time) required for a pulsed nozzle to produce a supersonic beam comparably cold to that obtained from a continuous source. The model is based on the notion that cooling will be complete if the leading edge of the beamlet reaches the terminal temperature prescribed by the steady state flow equations before the sound wave created at the back of the pulse by the nozzle's closing catches up with the leading edge. The times predicted from this model for reasonable stagnation conditions are all $\sim < 10$ μ s. 9 references, 2 tables.

34583 **Flowfield calculations in nonequilibrium freejets by the method of characteristics.** Labowsky, M.; Ryali, S.; Fenn, J.B.; Miller, D.R. (Yale Univ., New Haven, CT). *Rarefied Gas Dynamics;* **74**: 695-708(1981). Contract FG01-78ET11384.

From 12. international symposium on rarefied gas dynamics; Charlottesville, VA, USA (7-11 Jul 1980).

Numerical solutions of flow equations have been obtained by the Method of Characteristics for the supersonic freejet flow of rotationally relaxing diatomic gases. The results relate the terminal rotational temperature of the gas to the source conditions in terms of the intrinsic rotational relaxation rate. Comparison with similar results obtained by application of the sudden freeze assumption and by simple numerical integration of the relaxation rate equation in a pseudo-equilibrium model jet serves to identify the range of reliability of these simpler procedures. 9 references, 5 figures, 1 table.

4205 Materials Testing

REFER ALSO TO CITATION(S) 33801, 34335, 34400

34584 (AD-A—163822/0/XAB) Positron-annihilation studies of very-fine-structured materials. Final report, 1 July-31 August 1985. Jones, P.L. (Duke Univ., Durham, NC (USA). Dept. of Mechanical Engineering and Materials Science). 17 Dec 1985. 13p. NTIS, PC A02/MF A01.

An Fe-Nd-B permanent magnet alloy (Crumax 30) was evaluated as a function of thermal treatment by means of positron-annihilation lifetime spectroscopy. The results of this preliminary study indicate that the room-temperature lifetime spectra can be accurately modeled using either a two-component or a partially constrained three-component fit. The thermally-induced variations in lifetime spectra can be correlated with the concomitant decrease in magnetic coercivity in a manner that is consistent with thermally-induced microstructural transformations reported in the literature. The demonstrated sensitivity of positron-annihilation lifetime spectroscopy to thermally-induced changes in both microstructure and magnetic coercivity suggests that a more-thorough systematic positron-annihilation evaluation of Fe-R-B alloys could provide further insight into the relationship between processing, structure, and magnetic properties.

34585 (INIS-mf—9885) Optimization of acoustical holography of plated components of complicated geometry. Evaluation of the informative value of acoustical holography. Numerical simulation, curvature corrections. Haufe, U.; Montag, H.J.; Wuestenberg, H.; Erhard, A.; Ludwig, B. (Bundesanstalt fuer Materialpruefung, Berlin (Germany, F.R.)). Mar 1983. 87p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE86752049.

The establishment of synthetic holograms and the numerical simulation of the holographic imaging of, e.g., flat, rectangular reflecting bodies using a tandem arrangement are explained. The wave signals obtained on groove-type cracks and the problems involved in the evaluation of the intensity profiles obtained by acoustical holography of non-flat, cylindrically shaped reflectors are studied. The corrections for curvatures in flaw imaging are explained. Special features of the tandem arrangement for flaw detection on plated components are described. The window function for improving the accurateness of imaging by ultrasonic holography is discussed in the context of the general assessment of the informative value of holographic testing of plated components. The electronic equipment for measuring and recording is described. (DG).

34586 (SAND—85-2812) Measurement of linear-shaped charge jet penetration using an ultrasonic pulse echo technique. Hallett, S.G.; Gieske, J.H.; Walkington, P.D. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1986. Contract AC04-76DP00789. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010313.

A method for ultrasonically measuring the depth of penetration resulting from the detonation of aluminum linear-shaped charge (ALSC) into an aluminum target is described. The technique succeeds in determining the extent of jet penetration with exceptional accuracy and requires substantially less time to acquire the data than prior methods. Statistically, the greater number of points used to characterize the groove profile ultrasonically is superior to the measuring methods previously employed. These advantages suggest that the ultrasonic technique may potentially replace the laborious procedures currently used to measure jet penetration from ALSC detonation.

34587 (SAND—86-0509) Development of an ultra-low-load microhardness indentation test machine. Schmale, D.T.; Bourcier, R.J.; Martinez, E. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1986. Contract AC04-76DP00789. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011150.

As part of a program to characterize the mechanical response of surface modified materials, a microhardness indentation test machine has been developed. An electromagnetic drive system controls a diamond indenter which is suspended on a low friction ball slide. The test specimen is mounted on a cantilevered arm in a vertical plane perpendicular to the indentation direction on an X-Y micrometer translation system. Tests are controlled with a 16-bit A/D closed loop digital controller/function generator designed for this system. Load is monitored with a strain gage load cell while displacement is measured with a set of capacitance probes. Load/depth/time data are stored on a digital oscilloscope which is linked to a DEC LSI 11/23 for subsequent processing. The system allows indentation loading up to 1 kg with load resolutions of 5 mg and a depth resolution of 10 nm.

34588 Wave propagation in the split Hopkinson pressure bar. Follansbee, P.S.; Frantz, C. (Los Alamos National Lab., NM). *Journal of Engineering Materials and Technology;* **105:** 61-66(Jan 1983).

Elastic wave propagation in the split Hopkinson pressure bar (SHPB) is discussed with an emphasis on the origin and nature of the oscillations that often trail the leading edge of the pressure wave. The authors show that in the conditions of the SHPB test the pressure bars vibrate in the fundamental mode and that elastic wave progapation can be fully described mathematically. Excellent agreement is found between experimental results and predictions of the mathematical treatment. This suggests that dispersion effects in the pressure bars can be removed from the strain gage records, which reduces the magnitude of the oscillations in the resulting stress strain curve. 12 references, 11 figures, 1 table.

34589 (ORNL/tr—86/19) Concept for the quality assurance of components of the ceramic gas turbine by nondestructive testing. Goebbels, K.; Reiter, H.; Arnold, W.; Hirsekorn, S. (Oak Ridge National Lab., TN (USA); Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e.V., Saarbruecken (Germany, F.R.). Inst. fuer Zerstoerungsfreie Pruefverfahren). [1986]. Contract AC05-84OR21400. Translation of BMFT-FB-T-85-094, Aug 1985. 55p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86011474.

This work to develop nondestructive testing (NDT) methods for components made from high temperature and high strength ceramics was sponsored during the years 1977-1983 by the BMFT in a ceramic gas turbine program. The central task was to make available NDT methods for the detection of defects with linear dimensions between 10 and 100 μm. The presented final report demonstrates the elaborated concept for the quality assurance. For the surface and volume defects and the structure and stress measurement three methods are well to the fore: high resolution radiography, filmless with microfocal x-ray tubes and projection technique. This kind of testing is accomplished by cross section images of the computer tomography with reduced resolution; ultrasonic testing and ultrasonic microscopy with frequencies between 5 and 200 MHz: structure characterization (homogeneity) and stress measurement by low frequency (≦20 MHz) velocity measurements. Detection of surface defects with surface waves. A detection and characterization of volume defects is possible with high frequency ultrasound; and vibration analysis (resonance frequency) for large sample series, qualitative and integral characterization of components.

4207 Vacuum Engineering

34590 Manipulaton hairing thermally conductive rotary joint for transferring heat from a test specimen. Haney, S. J.; Stulen, R. H.; Toly, N. F. (to The United States of America as represented by the United States Department of Energy). US Patent 4,538,068. 27 Aug 1985. Filed date 3 May 1983. vp.

PAT-APPL-491134.

A manipulator for rotatably moving a test specimen in an ultra-high vacuum chamber includes a translational unit movable in three mutually perpendicular directions. A manipulator frame is rigidly secured to the translational unit for rotatably supporting a rotary shaft. A first copper disc is rigidly secured to an end of the rotary shaft for rotary movement within the vacuum chamber. A second copper disc is supported upon the first disc. The second disc receives a cryogenic cold head and does not rotate with the

first disc. A sapphire plate is interposed between the first and second discs to prevent galling of the copper material while maintaining high thermal conductivity between the first and second discs. A spring is disposed on the shaft to urge the second disc toward the first disc and compressingly engage the interposed sapphire plate. A specimen mount is secured to the first disc for rotation within the vacuum chamber. The specimen maintains high thermal conductivity with the second disc receiving the cryogenic transfer line.

4208 Electronic Circuits And Devices

REFER ALSO TO CITATION(S) 34348, 34365, 34691, 34693, 34699, 35332

34591 (INIS-mf—10111, pp 27) **Measurement of nonlinearity of analog-to-digital converters.** Horak, Z. (Ustav Jaderneho Vyzkumu CSKAE, Rez, Czechoslovakia). May 1985. (In Czech). NTIS (US Sales Only), PC A03/MF A01. File Number DE86701997. (CONF-8505256—Absts.).

From IAA conference on instrumental activation analysis; Klucenice, Czechoslovakia (12 May 1985).

34592 (INIS-mf—10111, pp 28) **Comparison of linearity for different analog-to-digital converters.** Dryak, P.; Tluchor, D.; Kokta, L.; Jiranek, V. (Ustav pro Vyzkum, Vyrobu a Vyuziti Radioisotopu, Prague, Czechoslovakia; Vyzkumny Ustav Potravinarskeho Prumyslu, Prague, Czechoslovakia). May 1985. (In Czech). NTIS (US Sales Only), PC A03/MF A01. File Number DE86701997. (CONF-8505256—Absts.).

From IAA conference on instrumental activation analysis; Klucenice, Czechoslovakia (12 May 1985).

34593 **(LA-UR—86-188) Analysis of equivalent capacitances between mutually coupled windings.** Chowdhuri, P. (Los Alamos National Lab., NM (USA)). 1986. Contract W-7405-ENG-36. 6p. (CONF-860705—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86006019.

From IEEE Power Engineering Society summer meeting; Mexico City, Mexico (20 Jul 1986).

The interwinding capacitance between mutually coupled windings may play a significant role in the transient analysis of these windings. Neglecting this capacitance or dividing it equally among the interwinding node pairs would then result in considerable inaccuracy in the analysis. A method is proposed to calculate equivalent interwinding capacitances which will reduce this inaccuracy. It is illustrated by simple winding models.

34594 **(LA-UR—86-428) Thermionic integrated circuits.** MacRoberts, M.; Brown, D.R.; Dooley, R.; Lemons, R.; Lynn, D.; McCormick, B.; Mombourquette, C.; Sinah, D. (Los Alamos National Lab., NM (USA)). 1986. Contract W-7405-ENG-36. 5p. (CONF-860706—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86005849.

From 23. annual conference on nuclear and space radiation effects; Providence, RI, USA (20 Jul 1986).

Thermionic integrated circuits combine vacuum-tube technology with integrated-circuit techniques to form integrated vacuum circuits. These circuits are capable of extended operation in both high-temperature and high-radiation environments.

34595 **(NP—6901422) World standards for electrical and electronic engineering. Catalogue of publications complete to 1st January 1986.** (Commission Electrotechnique Internationale, Geneva (Switzerland)). 1986. 336p. NTIS (US Sales Only), PC A15/MF A01. File Number DE86901422.

This catalogue lists all IEC standards issued as of January 1, 1986. They are widely adopted by the member National Committees as the basis of their national electrotechnical standards so far as local customs and conditions permit. They are also quoted in manufacturers' specifications and by users, for instance, when calling for tenders. This widespread adoption facilitates international trade in the electrical and electronic engineering sectors.

34596 **(SAND—86-0340C) Rail span analysis applied to a gate array.** Ackermann, M.R.; Mikawa, R.E.; Pierce, D.G.; Gover, J.E. (Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 5p. (CONF-860706—10). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86007709.

From 23. annual conference on nuclear and space radiation effects; Providence, RI, USA (20 Jul 1986).

The technique of Rail Span Analysis is applied to a 2 micron, 2 level metal CMOS grate array. The analysis suggests that the array could be made hard to in excess of 1E10 Rads(Si)/s. The substrate and epi layer resistances prove to be a limiting factor at high dose rates.

34597 **(SAND—86-0341C) Factors contributing to static RAM cell transient upset.** Ackermann, M.R.; Mikawa, R.E. (Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 5p. (CONF-860706—9). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86007710.

From 23. annual conference on nuclear and space radiation effects; Providence, RI, USA (20 Jul 1986).

Rail Span Collapse is proposed to be the dominant transient upset mechanism in CMOS static random access memories. This paper examines the many factors contributing to RAM cell upset and comments on the strengths and weaknesses of the rail span model.

34598 **(UCRL—50025-86-1) Electronics Engineering Department technical review.** (Lawrence Livermore National Lab., CA (USA)). Apr 1986. Contract W-7405-ENG-48. 41p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86011371.

The EE Technical Review has two purposes - to inform readers of various activities within the Electronics Engineering Department and to promote the exchange of ideas. The articles, by design, are brief summaries of EE work. For further details on a subject covered, please contact one of the authors. The authors are primarily responsible for the content of their articles. Inasmuch as most projects are the result of the cooperative efforts of many individuals, the person you contact will either provide the requested information directly or refer you to the appropriate person to answer your question.

34599 **Minimum transition values and the dynamics of subcritical bifurcation.** Tu, S.; Reiss, E.L. (Dept. of Engineering Sciences and Applied Mathematics, Northwestern Univ., Evanston, IL 60201). *SIAM Journal on Applied Mathemadics;* **46**: No. 2, vp(Apr 1986).

Perturbation and asymptotic methods are presented for analyzing a class of subcritical bifurcation problems whose solutions possess minimum transition values. These minimum transition values are determined. In addition, the dynamics of the transitions from the basic state to the larger amplitude bifurcation states are obtained. The effects of imperfections on the response of the systems are also investigated. The method is presented for two model problems. However, it is valid for a wide class of problems in elastic and hydrodynamic stability, in reaction-diffusion systems and in other applications. In the first problem the authors obtain subcritical steady bifurcation states for a one-dimensional nonlinear diffusion problem. In the second problem they consider the subcritical Hopf bifurcation of periodic solutions for a higher order van der Pol-Duffing oscillator.

34600 **Servo control booster system for minimizing following error.** Wise, W.L. (to Dept. of Energy). US Patent 4,553,078. 12 Nov 1985. Filed date 26 Jul 1979. vp.

PAT-APPL-61114.

A closed-loop feedback-controlled servo system is disclosed which reduces command-to-response error to the system's position feedback resolution least increment, ΔS /sub R/, on a continuous real-time basis for all operating speeds. The servo system employs a second position feedback control loop on a by exception basis, when the command-to-response error ≧ΔS /sub R/, to produce precise position correction signals. When the command-to-response error is less than ΔS /sub R/, control automatically reverts to con-

ventional control means as the second position feedback control loop is disconnected, becoming transparent to conventional servo control means. By operating the second unique position feedback control loop used herein at the appropriate clocking rate, command-to-response error may be reduced to the position feedback resolution least increment. The present system may be utilized in combination with a tachometer loop for increased stability.

34601 **Eight electrode optical readout gap.** Boettcher, G.E.; Grain, R.W. (to Dept. of Energy). US Patent 4,550,273. 29 Oct 1985. Filed date 25 Apr 1983. vp.

PAT-APPL-488338.

A protective device for a plurality of electrical circuits includes a plurality of isolated electrodes forming a gap with a common electrode. An output signal, electrically isolated from the circuits being monitored, is obtained by a photosensor viewing the discharge gap through an optical window. Radioactive stabilization of discharge characteristics is provided for slowly changing voltages and carbon tipped dynamic starters provide desirable discharge characteristics for rapidly varying voltages. A hydrogen permeation barrier is provided on external surfaces of the device.

34602 **Non-bonded piezoelectric ultrasonic transducer.** Eoff, J. M. (to The United States of America as represented by the United States Department of Energy). US Patent 4,544,859. 1 Oct 1985. Filed date 6 Jul 1984. vp.

PAT-APPL-628078.

A mechanically assembled non-bonded ultrasonic transducer includes a substrate, a piezoelectric film, a wetting agent, a thin metal electrode, and a lens held in intimate contact by a mechanical clamp. No epoxy or glue is used in the assembly of this device.

34603 **Wide-range lock-in amplifier.** McNeilly, D. R. (to The United States of America as represented by the United States Department of Energy). US Patent 4,542,346. 17 Sep 1985. Filed date 7 Dec 1982. vp.

PAT-APPL-447728.

A lock-in amplifier is provided which allows detection of a signal buried in noise without preprocessing of the input signal. An analog signal multiplier is used to obtain a dc output which is the product of the signal being detected and a high-purity sine wave signal. A reference signal of a known selectable frequency is applied to a sine-wave generator to generate the sine wave of the same frequency. The sine wave is applied to a multiplier through a phase shift arrangement to allow the detection of both amplitude of the detected signal and the phases relative to the reference signal. The multiplier output is filtered by a low-pass filter to eliminate unwanted frequency components from the output signal.

4210 Combustion Systems

REFER ALSO TO CITATION(S) 33645, 33728, 34206

34604 **(DOE/PC/80511—T3) Hydrodynamics, mixing and segregation in gas fluidized beds. Technical progress report, 22 January-21 April 1986.** Chen, M.M.; Chao, B.T. (Illinois Univ., Urbana (USA). Dept. of Mechanical and Industrial Engineering). 1986. Contract FG22-85PC80511. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010659.

This technical progress report covers the progress made during the period 22 January through 21 April 1986. The measurements of the solids turbulent stresses and turbulent mixing in a fluidized bed were made by using the Computer-Aided Particle Tracking Facility (CAPTF) at the University of Illinois at Urbana-Champaign operating in the single and multi-particle tracking modes. The turbulent stresses and the experimentally derived eddy diffusivities were obtained in an effort to understand the governing equations of solids dynamics. By analogy, the eddy diffusivities were also used for the numerical simulation of solids mixing in the fluidized bed. Heat transfer between particle-particle and particle-wall impact was also studied analytically. The process is one component of the overall heat transfer process in fluidized beds. 4 refs., 5 figs.

4220 Underground Engineering

34605 **(EPRI-EM—4587) Underground cavern excavation. Final report.** (Cementation Co. of America, Inc., Tucson, AZ; Acres American, Inc., Buffalo, NY). May 1986. 138p. Research Reports Center, Box 50490 Palo Alto, CA 94303. File Number TI86920312.

Building power plants and energy storage facilities underground offers an attractive solution to increasingly stringent environmental regulations and the high cost of land. Advances in excavation technology and new approaches to construction management can reduce the risks and costs of working underground.

4240 Pollution Control Equipment

REFER ALSO TO CITATION(S) 33570, 33571, 33572, 33573, 33574, 33575, 33576, 33577, 33578, 33579, 33580, 33581, 33582, 33583, 33584, 33585, 33586, 33587, 33588, 33589, 33590, 33591, 33593, 33600, 33605, 33608, 33619, 34736, 34737

34606 (EPRI-CS—4390-Vol.2, pp 11.45-11.57) **Corrosion resistance of a Cr-Ni-Mo-Cu-Fe alloys in scrubber environments and other chemicals.** DeBold, T.A.; Frick, D.G.; Bauer, G.A. (Carpenter Technology Corp., Reading, PA). Jan 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920170. (CONF-850630—Vol.2).

From 9. symposium on flue gas desulfurization; Cincinnati, OH, USA (4 Jun 1985).

A new austenitic stainless steel with optimized alloy content has been developed which provides a high level of resistance to scrubber environments and other chemicals. Laboratory data for several forms of attack including pitting, crevice, intergranular, and general corrosion are provided along with mechanical properties. Spool test data from several scrubber locations are included. 7 references, 1 figure, 14 tables.

43 PARTICLE ACCELERATORS

4301 Design, Development, And Operation

REFER ALSO TO CITATION(S) 34564

34607 (DOE/ER/01067—24, pp 173) **KN accelerator operation.** Westerfeldt, C.R.; Warthen, B.; Vanhoy, J.; Brooks, W.; Bilpuch, E.G.; Mitchell, G.E. 1985. NTIS, PC A10/MF A01. File Number DE86003851.

In Triangle Universities Nuclear Laboratory annual report - TUNL XXIV, 1 July 1984-31 August 1985.

The KN accelerator continues to operate very well at the increased terminal voltages. The accelerator tube has now operated for 5500 hours at terminal voltages between 1 MV and 4.1 MV. The authors have recently discovered damage to three sections of the accelerator tube near the high energy end and have shorted one section to prevent further damage. Despite this damage the authors have since operated successfully at terminal potentials up to 4.1 MV with no difficulty. The charging belt has a total of 4900 hours of use and is working well. The new charging and collector screens have improved the terminal stability. The automation of the energy-stepping system has been essentially completed and the collimation system in the new 17° scattering chamber has been modified in order to improve the low-energy background in the charged particle spectra.

34608 (DOE/ER/01067—24, pp 174-175) **Tandem accelerator operation.** Rummel, R.L.; Carter, E.P.; Westerfeldt, C.R. 1985. NTIS, PC A10/MF A01. File Number DE86003851.

In Triangle Universities Nuclear Laboratory annual report - TUNL XXIV, 1 July 1984-31 August 1985.

For the period July 1, 1984 through July 31, 1985 the FN tandem accelerator was operated for 6760 hours. This represents 72% utilization of the maximum available machine time for the past

13 months. The total running time for this machine is now 104,470 hours, and the age of two of the accelerator tubes exceeds 100,000 hours. In August of last year the authors removed the liquid-nitrogen trapped mercury diffusion pump on the low energy end of the accelerator. In its place the authors installed a Varian Cryostack cryopump along with a new NEC beam scanner, a new set of beam chopper plates, and new vacuum gauges and protection circuits. The vacuum in the low energy tube has been improved from 5 x 10^{-6} to 5 x 10^{-7} Torr.

34609 **(DOE/SF/00515—T63) Stanford Linear Accelerator Center monthly report for April 1986.** (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Apr 1986. Contract AC03-76SF00515. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011144.

Accelerator and research operation data are provided, as well as research area and experiment status. A tentative long-range schedule and table of approved experiments are included. Efforts in accelerator improvement, data analysis, and SPEAR development are briefly summarized. 31 refs. (LEW)

34610 **(EGG—10282-2090) EG and G electron linac modifications.** Norris, N.J.; Detch, J.L.; Kocimski, S.M.; Sawyer, C.R.; Hudson, C.L. (EG and G Energy Measurements, Inc., Goleta, CA (USA). Santa Barbara Operations). 1986. Contract AC08-83NV10282. 4p. (CONF-860629—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010664.

From Linear accelerator conference; Stanford, CA, USA (2 Jun 1986).

A three-year modification of the EG and G electron linac has been performed to replace obsolete equipment and bring all subsystems up to the current state of the art. Components and subsystems were designed, constructed, and tested off-line to minimize interruption of experiments. The configuration of the modified linac is shown schematically, and performance characteristics are give. Each subsystem is described, including: the electron gun; solenoid focusing system; subharmonic bunchers; accelerating system; RF system; klystron modulators and power supplies; control system; beam handling system; vacuum system; and beam current monitors. 7 refs., 4 figs., 2 tabs.

34611 (INIS-BR—461, pp 19-21) **Radiological shielding of fast neutrons beams.** Suita, J.C.; Cabral, S.C.; Fajardo, P.W. 1984. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. File Number DE86702106.

In Annual technical report of Nuclear Engineering Institute - Physics Department - 1984.

34612 **(LA-UR—86-1719) Mechanical features of the ATS ramped-gradient DTL.** Liska, D.J.; McCauley, G.; Carlisle, L.O. (Los Alamos National Lab., NM (USA)). 1986. Contract W-7405-ENG-36. 3p. (CONF-860629—7). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011215.

From Linear accelerator conference; Stanford, CA, USA (2 Jun 1986).

At Los Alamos, a short, lightweight drift-tube linac (DTL) has been designed. This accomplishment is possible by varying the accelerating gradient from 2 MV/m at the RFQ end to 4.4 MV/m at the output end, with the gradient rising as a cubic polynomial. The object of raising the gradient to such a high level is to reduce the length of the proposed 50-MeV machine that ultimately will attach to the ramped-gradient drift-tube linac (RGDTL) tank. This is the first proton linac structure to propose such a ramping scheme and the first to attempt reliable long-term operation at such elevated accelerating gradients. It is also the first to attempt to accomplish this with a lightweight aluminum structure designed to operate at 5% duty factor.

34613 **(LA-UR—86-1733) C-w operation of a 2-MeV RFQ accelerator.** Cornelius, W.D. (Los Alamos National Lab., NM (USA)). 1986. Contract W-7405-ENG-36. 4p. (CONF-860629—8). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011217.

From Linear accelerator conference; Stanford, CA, USA (2 Jun 1986).

We have achieved reliable cw operation of the Fusion Materials Irradiation Test (FMIT) radio-frequency quadrupole (RFQ) accelerator and have accelerated 40 mA of H_3^+ beam to an energy of 2 MeV. The technical considerations for future cw accelerator designs, based on our experience in achieving cw operation, will be presented. Also to be discussed are measurements of beam emittance, matching into the RFQ, and beam transmission through the accelerator. These measurements will be compared with results of theoretical simulations of the device. The diagnostics instrumentation developed for characterizing intense cw beams also will be discussed, as well as the performance of those devices.

34614 **(SLAC—102) SLAC Users Bulletin No. 102, November 1985-April 1986.** Keller, L.P.; Edminster, D. (eds.). (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). 1986. Contract AC03-76SF00515. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011098.

The status experimental activities at SLAC is reported, including the long-range schedule and a list of approved high-energy experiments. Work on PEP, SPEAR, and the SLC is included, as well as computing. Such operational data as operating hours and experimental hours are given. (LEW)

34615 **(SLAC-PUB—3942) Circular machine design techniques and tools.** Servranckx, R.V.; Brown, K.L. (Saskatchewan Univ., Saskatoon (Canada); Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Apr 1986. Contract AC03-76SF00515. 16p. (CONF-860520—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010851.

From Conference on charged particle optics; Los Alamos, NM, USA (19 May 1986).

Some of the basic optics principles involved in the design of circular accelerators such as Alternating Gradient Synchrotrons, Storage and Collision Rings, and Pulse Stretcher Rings are outlined. Typical problems facing a designer are defined, and the main references and computational tools are reviewed that are presently available. Two particular classes of problems that occur typically in accelerator design are listed - global value problems, which affect the control of parameters which are characteristic of the complete closed circular machine, and local value problems. Basic mathematical formulae are given that are considered useful for a first draft of a design. The basic optics building blocks that can be used to formulate an initial machine design are introduced, giving only the elementary properties and transfer matrices only in one transverse plane. Solutions are presented for some first-order and second-order design problems. (LEW)

34616 **(UCID—20755) Thermal management for LLNL/UC/SSRL bending magnet beamline VIII at Stanford Synchrotron Radiation Laboratory.** Berglin, E.J.; Younger, F.C. (Lawrence Livermore National Lab., CA (USA); Brobeck Corp., Berkeley, CA (USA)). May 1986. Contract W-7405-ENG-48. 49p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86011007.

All the important heat loads on the elements of Beamline VIII are cataloged. The principal elements are identified and their heat loads tabulated for various loading scenarios. The expected heat loads are those from normal operations including the anticipated performance improvements planned for the SPEAR ring and from abnormal operations due to positional perturbations of the electron beam. (LEW)

34617 **Dual aperture dipole magnet with second harmonic component.** Praeg, W. F. (to USA as represented by the US Dept. of Energy). US Patent 4,559,578. 17 Dec 1985. Filed date 31 Aug 1983. vp.

PAT-APPL-528278.

An improved dual aperture dipole electromagnet includes a second-harmonic frequency magnetic guide field winding which surrounds first harmonic frequency magnetic guide field windings associated with each aperture. The second harmonic winding and the first harmonic windings cooperate to produce resultant magnetic waveforms in the apertures which have extended acceleration and shortened reset portions of electromagnet operation.

34618 Calculation of Al(p,xn) and Cu(p,xn) thick-target neutron angular yields and spectra for E/sub p/ Δ 50 MeV. Arthur, E.D.; Wilson, W.B. (Los Alamos National Lab., NM). *Transactions of the American Nuclear Society;* **50**: 469-470(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

Present design effort of shielding for a high-current 50-MeV proton linear accelerator requires the accurate description of the neutron sources produced from proton spills at all energies of copper accelerator fixtures and from 50-MeV proton spills on aluminum beam tubes and carbon beam stops. The recent thick-target neutron spectra measurements for 30- and 52-MeV protons on carbon, iron, copper, and lead by Nakamura et al. provide part of the required source information. The remainder of the neutron source description has been obtained from theoretical calculations. Cross sections and associated neutron spectra for Al(p,xn) an Cu(p,xn) reactions from threshold to 50 MeV have been calculated at 5-MeV increments with the GNASH preequilibrium statistical nuclear model code.

34619 Operation of the Pulselac injector upgrade. Lockner, T.R.; Coats, R.S.; Johnson, D.J.; Mills, G.S. (Sandia National Labs., Albuquerque, NM). pp 2Q-3 of IEEE conference record-abstracts of the 1985 IEEE international conference on plasma science. Piscataway, NJ; IEEE Service Center (1985). (CONF-850699—). Contract AC04-76DP00789.

From Conference on plasma sciences; Pittsburgh, PA, USA (3 Jun 1985).

A new 1.0 MV, 10 ohm pulse power source has been added to the Pulselac C accelerator. The system includes a 10 ohm, 60 ns water blumlein, 2-20 ohm oil transmission lines and a Metglas core inductive cavity to supply over 1.0 MV to the Pulselac injector diode. Preliminary experiments on a PI 110 have been performed to determine the expected operating conditions in the diode. Space charge neutralization and magnetic insulation studies on this machine will be presented. Operation of the new injector will be described including pulse power, metglas cores, diode operation, beam divergence measurements, and diode efficiency. The field coil geometry has been altered to achieve magnetic field lines at the cathode surface which provide electrostatic focusing of the injected beam. The new geometry is modeled after the Proto I and Nereus field coil configurations using stainless steel volumes to shape the field as desired. Magnetic field simulations of the new geometry are presented.

4302 Beam Dynamics, Field Calculations, And Ion Optics

REFER ALSO TO CITATION(S) 34548, 34551, 34648

34620 (AD-A—163945/9/XAB) Particle-beam tracker for an accelerating target. Master's thesis. Jamerson, L.C. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Dec 1985. 110p. (AFIT/GE/ENG—85D-22). NTIS, PC A06/MF A01.

The purpose is to use a PI(Proportional plus INTEGRAL) controller to point the centroid of a particle beam at an intended target. Multiple Model Adaptive Estimator is used to estimate the centroid of a one-dimensionald Gaussian shaped source of photoelectron events. Merge Method of filter pruning is used to limit the size of this filter. A standard Kalman filter is used to estimate the position of the target where the target is initially modelled as a first-order Gauss Markov position process and later as a first-order Gauss Markov acceleration process. A PI controller is designed using LQG methods, and true states are replaced by their best estimates by invoking the principle of assumed certainty equivalence. With a target position model within the software, a parameter sensitivity analysis is performed as well as a robustness study where unmodelled constant and sinusoidal disturbances are added to the system. With a target acceleration model within the software, a robustness study is carried out where target parameters are varied within the truth model without telling the filter. In an attempt to recover full-state feedback robustness qualities, Loop Transmission Recovery tuning is attempted.

34621 (DOE/ER/01067—24, pp 180-183) **Diagnostic tests on buncher system.** Clegg, T.B.; Howell, C.R.; Roberts, M.L.; Westerfeldt, C.R. 1985. NTIS, PC A10/MF A01. File Number DE86003851.

In Triangle Universities Nuclear Laboratory annual report - TUNL XXIV, 1 July 1984-31 August 1985.

As discussed in the last annual report (Annual Report-TUNL XXIII) the time width of the beam bursts produced by the present bunching system are substantially broader than calculations indicate. Several possible causes for the poor timing were investigated: (1) time spread due to path length differences in the trajectories of the beam particles after the buncher, (2) ripple on d.c. voltages applied to the r.f. amplifier tube used to power the buncher, and (3) a larger beam energy spread at the bunching plane than previously estimated.

34622 (FNAL-TM—1393) Amplitude dependence of the tune shift. Gelfand, N.M. (Fermi National Accelerator Lab., Batavia, IL (USA)). Mar 1986. Contract AC02-76CH03000. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011664.

Recent studies in the Tevatron have measured the tune shift as a function of the displacement from a closed orbit. The measured values of tune shift were found to be much smaller than one would expect from the measured distribution of the normal octupole moments in the Tevatron. Tracking studies performed to see if, and under what conditions, the observed results could be obtained are reported. The effect of linear coupling is taken into consideration, and is found to significantly reduce the coefficient of the tune shift. The dependence of the tune shift on the initial coordinate of a particle in the presence of a distribution of octupole moments is calculated. The "smear" is calculated as a function of linear coupling. (LEW)

34623 (LA-UR—86-1683) Proper input phase-space filling for accurate beam-dynamics codes. Boicourt, G.P.; Vasquez, M.C. (Los Alamos National Lab., NM (USA)). 1986. Contract W-7405-ENG-36. 4p. (CONF-860629—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011247.

From Linear accelerator conference; Stanford, CA, USA (2 Jun 1986).

In the future, more attention will be required concerning the filling of the input phase space used by particle-simulation codes. The prospect of greatly improved particle-tracking codes implies that code input distributions must be accurate models of real input distributions. Much of present simulation work is done using artificial phase-space distributions (K-V, waterbag, etc.). Real beams can differ dramatically from such ideal input. We have already developed a method for deriving code input distributions from measurements. This paper addresses the problem of determining the number of pseudoparticles needed to model the measured distribution properly.

34624 (LJI-R—86-392) Nonlinear beam dynamics of accelerators and storage rings. Progress report, June 1985-April 1986. Helleman, R.H.G. (La Jolla Inst., CA (USA). Center for Studies of Nonlinear Dynamics). 1986. Contract AC03-84ER40182. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010759.

Research has concentrated on the stability problems and resonances involved in the two-dimensional beam-beam effect. Of course, the results are applicable also to coupled nonlinear two-dimensional (x,y) accelerator lattices. From a nonlinear dynamics point of view this means that we investigated how to extend existing methods that worked satisfactorily for the one-dimensional beam-beam effect to the higher dimensional world of two-dimensional nonlinear lattices. This requires study of four coupled nonlinear lattice equations (for x, y, p/sub x/,p/sub y/), i.e., study of four-dimensional conservative nonlinear maps. Until our investigation this year, such maps had not yet been studied in nonlinear dynamics. One of the main results is the conclusion that the very successful "residue" method to determine stability (of whole regions of orbits) for the one-dimensional beam-beam effect cannot, in its present form, be used for the two- or three-dimensional case. The second main result is that we have been successful in demonstrating

and unraveling the complete Period Doubling structure of the resonances in these four-dimensional maps (two-dimensional beam-beam effect), including the most minute resonances. This is essential for an understanding of such maps. In addition, it is the "self-similarity" of these resonances which inspires, and guides, most of our efforts in redesigning the residue criterion mentioned above.

34625 **(SLAC-CN—330) New limits on residual RTL eta from Linac wakefields.** Seeman, J.T. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). 16 May 1986. Contract AC03-76SF00515. 16p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86011516.

Effects of Linac transverse wakefields are combined with residual eta and partially compressed bunches (presently the SLC design) to place much tighter, current dependent limits on residual eta and eta'. The limits are comparable to or exceed those needed at the SLC final focus. These limits will be difficult to maintain due to present experimental resolution.

34626 **(SLAC-PUB—3891) Wake field accelerators.** Wilson, P.B. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Feb 1986. Contract AC03-76SF00515. 23p. (CONF-860736—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86009781.

From SLAC summer institute on particle physics; Stanford, CA, USA (29 Jul 1986).

In a wake field accelerator a high current driving bunch injected into a structure or plasma produces intense induced fields, which are in turn used to accelerate a trailing charge or bunch. The basic concepts of wake field acceleration are described. Wake potentials for closed cavities and periodic structures are derived, as are wake potentials on a collinear path with a charge distribution. Cylindrically symmetric structures excited by a beam in the form of a ring are considered. (LEW)

4303 Auxiliaries And Components

REFER ALSO TO CITATION(S) 34652, 34654, 34677

34627 **(CERN-EP—86-39) Large-area transition radiation detectors for electron identification in the UA6 experiment at the CERN p anti p Collider.** Vacchi, A. (European Organization for Nuclear Research, Geneva (Switzerland); Rockefeller Univ., New York (USA). Dept. of Physics). 24 Mar 1986. Contract AC02-81ER40033. 11p. (CONF-860272—11). NTIS, PC A02/MF A01; GPO Dep. File Number DE86010912.

From Wire chamber conference; Vienna, Austria (25 Feb 1986).

Two transition radiation detectors (TRDs) to provide electron-pion discrimination have been built for the UA6 spectrometer at the CERN p anti p Collider. The sensitive area is (1152 x 778) mm. The x-ray detector is a proportional chamber with a 10 mm cathode-anode gap and a thin entrance window. The radiator consists of Li foils in a He atmosphere. The chamber uses a fully recycled He + Xe + CO_2 gas mixture. The gas system is remotely controlled. Stable working conditions have been achieved over long periods. The first results agree with the expected performance. 5 refs., 5 figs.

34628 **(CONF-8604184—1) Argonne superconducting heavy-ion linac.** Shepard, K.W. (Argonne National Lab., IL (USA)). 1986. Contract W-31-109-ENG-38. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010504.

From Symposium on 10 years of uranium beam; Darmstadt, F.R. Germany (2 Apr 1986).

The present ATLAS configuration has two important limitations: relatively weak beam currents, and an inability to accelerate ions in the upper half of the periodic table. Both of these limitations are due to the tandem part of the system. The next step in the evolution of ATLAS is the development of a very low velocity linac for a positive-ion injector to replace the tandem as the injector of the present superconducting linac. This development is expected to increase substantially the available beam current, and also to extend the mass range of the accelerator system, eventually to uranium.

34629 (DOE/ER/01067—24, pp 155-165) **Cryogenic polarized target facility: status.** Gould, C.; Nash, H.K.; Robertson, N.; Schneider, M.; Seagondollar, W.; Soderstrum, J. 1985. NTIS, PC A10/MF A01. File Number DE86003851.

In Triangle Universities Nuclear Laboratory annual report - TUNL XXIV, 1 July 1984-31 August 1985.

The TUNL cryogenically polarized target facility consists of a ^{3}He-^{4}He dilution refrigerator and a superconducting magnet, together capable of maintaining samples at between 10 and 20 mK in magnetic fields up to 7 Tesla. At these temperatures and magnetic fields brute-force nuclear orientation occurs. Polarizations from 20 to 60% are attainable in about twenty nonzero spin nuclei. Most are metals, ranging in mass from ^{6}Li to ^{209}Bi, but the nuclei ^{1}H and ^{3}He are also polarizable via this method. The main effort is directed towards a better determination of the effective spin-spin force in nuclei. These experiments are briefly described and the beam stabilization system, cryostat and polarized ^{3}He targets are discussed.

34630 (DOE/ER/01067—24, pp 175-176) **Helium-ion source improvements.** Gibbons, T.; Fauber, R.; Ludwig, E. 1985. NTIS, PC A10/MF A01. File Number DE86003851.

In Triangle Universities Nuclear Laboratory annual report - TUNL XXIV, 1 July 1984-31 August 1985.

In the past few months several changes have been made in the source used to produce beams of ^{3}He and ^{4}He. It is hoped these changes will eventually produce 7 to 10 μa of negative beam after the analyzing magnet compared to the 3.5 to 4 μa previously obtained. The major change made in the source is the use of sodium as opposed to lithium in the charge-exchange canal. To allow the use of sodium in the source, the oven-heater system and the condenser units were redesigned.

34631 (DOE/ER/01067—24, pp 176-177) **Polarized source upgrading.** Clegg, T.B.; Rummel, R.L.; Carter, E.P.; Westerfeldt, C.R.; Lovette, A.W.; Edwards, S.E. 1985. NTIS, PC A10/MF A01. File Number DE86003851.

In Triangle Universities Nuclear Laboratory annual report - TUNL XXIV, 1 July 1984-31 August 1985.

The decision was made this past year to move the Lamb-shift polarized ion source which was first installed in the laboratory in 1970. The motivation was the need to improve the flexibility of spin-axis orientation by installing the ion source with a new Wien-filter spin precessor which is capable of rotating physically about the beam axis. The move of the polarized source was accomplished in approximately two months, with the accelerator being turned off for experiments during approximately four weeks of this time. The occasion of the move provided the opportunity to rewire completely the entire polarized ion source frame and to rebuild approximately half of the electronic chassis on the source. The result is an ion source which is now logically wired and carefully documented. Beams obtained from the source are much more stable than those previously available.

34632 (DOE/ER/01067—24, pp 177-178) **Planning for a new polarized source.** Clegg, T.B. 1985. NTIS, PC A10/MF A01. File Number DE86003851.

In Triangle Universities Nuclear Laboratory annual report - TUNL XXIV, 1 July 1984-31 August 1985.

In anticipation of obtaining funds for a new polarized source, the authors have tried to stay abreast of new source technological developments. In particular, the authors have worked to try to understand methods for improving the atomic beam polarized source. It seems interesting to consider whether the large ionization efficiency of an electron-cyclotron-resonance source could be maintained if such a source were used as an ionizer for the polarized atomic beam. An analysis of this application suggests that such an ECR ionizer might produce outgoing ion-beam intensities which are up to five times larger than those presently achieved with electron bombardment ionizers. Furthermore, the concern previously expressed that the ECR ionizer would cause resonant depolarization of the atomic beam before ionization seems unlikely.

34633 (DOE/ER/01067—24, pp 178-179) **Optically pumped polarized ion sources.** Schneider, M.B.; Clegg, T.B. 1985. NTIS, PC A10/MF A01. File Number DE86003851.

In Triangle Universities Nuclear Laboratory annual report - TUNL XXIV, 1 July 1984-31 August 1985.

Since the research program at TUNL has long had the study of polarization phenomena as a central part, it seemed natural to keep aware and involved with some recent developments in polarized source technology. With this in mind, the authors pursued a feasibility study of optically pumped polarized ion sources for the sort of research done at TUNL. This has led to some theoretical investigations of the phenomenon of radiation trapping, an atomic physics effect which is one of the least understood and most limiting processes in these sources.

34634 (DOE/ER/01067—24, pp 179-180) **Proton polarization monitor.** Spencer, T.C.; Ludwig, E.J. 1985. NTIS, PC A10/MF A01. File Number DE86003851.

In Triangle Universities Nuclear Laboratory annual report - TUNL XXIV, 1 July 1984-31 August 1985.

The construction, testing, and calibration of a new proton polarization monitor was completed in nearly 1985. This device was subsequently used during the spring for a high resolution Ne(p,p') run. The polarimeter continuously monitors the polarization of an incident proton beam using the ^{4}He(p,p) reaction at 125° in the center of mass frame.

34635 (DOE/ER/01067—24, pp 184-189) **TUNL computer facilities.** Boyd, M.; Edwards, S.E.; Gould, C.R.; Roberson, N.R.; Westerfeldt, C.R. 1985. NTIS, PC A10/MF A01. File Number DE86003851.

In Triangle Universities Nuclear Laboratory annual report - TUNL XXIV, 1 July 1984-31 August 1985.

The XSYS system has been relatively stable during the last year, and most of our efforts have involved routine software maintenance and enhancement of existing XSYS capabilities. Modifications were made in the MBD program GDAP to increase the execution speed in key GDAP routines. A package of routines has been developed to allow communication between the XSYS and the new Wien filter microprocessor. Recently the authors have upgraded their operating system from VSM V3.7 to V4.1. This required numerous modifications to XSYS, mostly in the command procedures. A new reorganized edition of the XSYS manual will be issued shortly. The TUNL High Resolution Laboratory's VAX 11/750 computer has been in operation for its first full year as a replacement for the PRIME 300 computer which was purchased in 1974 and retired nine months ago. The data acquisition system on the VAX has been in use for the past twelve months performing a number of experiments.

34636 (INIS-BR—461, pp 1-2) **Operation and maintenance of cyclotron.** Furlanetto, J.A.D.; Abrahao, J.C.; Salgado, L.C.C.; Rodrigues, A.M.R.; Ferreira, C.A.S.; Lemos, M.L.B.; Ceia, N.M.; Miranda, P.C.F.; Lima, J. (Instituto de Engenharia Nuclear, Rio de Janeiro, Brazil. Dept. de Fisica). 1984. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. File Number DE86702106.

In Annual technical report of Nuclear Engineering Institute - Physics Department - 1984.

34637 (INIS-BR—461, pp 6-10) **Experimental assembly for fast neutron production in CV-28 cyclotron.** Cabral, S.C.; Suita, J.C.; Auler, L.T.; Rezende, H.C. de. 1984. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. File Number DE86702106.

In Annual technical report of Nuclear Engineering Institute - Physics Department - 1984.

34638 (INIS-BR—461, pp 57) **Confinement system-cyclotron cavern-reception cell and dismounting.** Almeida, G.L. de; Miranda, P.C.F.; Rodrigues, A.M.R.; Rautenberg, F.A. 1984. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. File Number DE86702106.

In Annual technical report of Nuclear Engineering Institute - Physics Department - 1984.

34639 (INIS-BR—461, pp 60-63) **System of beam transport to study irradiation damage.** Abreu, A.S. de; Santos, G.R. dos; Costa Martha, Z. da; Marques, L.A.V.; Rezende, H.C. de; Goncalves, Z.C. 1984. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. File Number DE86702106.

In Annual technical report of Nuclear Engineering Institute - Physics Department - 1984.

34640 (LA-UR—86-1587) **Control of linear accelerator noise in the Los Alamos free-electron laser (FEL).** Lynch, M.T. (Los Alamos National Lab., NM (USA)). 1986. Contract W-7405-ENG-36. 4p. (CONF-860629—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011259.

From Linear accelerator conference; Stanford, CA, USA (2 Jun 1986).

The Los Alamos FEL requires tight control of the amplitudes and phases of the fields in two linear accelerator tanks to obtain stable lasing. The accelerator control loops must establish constant, stable, repeatable amplitudes and phases of the rf fields and must have excellent bandwidth to control high-frequency noise components. A model of the feedback loops has been developed that agrees well with measurements and allows easy substitution of components and circuits, thus reducing breadboarding requirements. The model permits both frequency and time-domain analysis. This paper describes the accelerator control scheme and our model and discusses the control of noise in feedback loops, showing how low-frequency-noise components (errors) can be corrected, but high-frequency-noise components (errors) are actually amplified by the feedback circuit. Measurements of noise in both open- and closed-loop modes are shown and comparison is made with results from the model calculations.

34641 (LA-UR—86-1601) **Multiple-measurement beam probe.** Gilpatrick, J.D.; Grant, D.L. (Los Alamos National Lab., NM (USA)). 1986. Contract W-7405-ENG-36. 4p. (CONF-860629—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011257.

From Linear accelerator conference; Stanford, CA, USA (2 Jun 1986).

Particle accelerators are becoming smaller and are producing more intense beams; therefore, it is critical that beam-diagnostic instrumentation provide accelerator operators and automated control systems with a complete set of beam information. Traditionally, these beam data were collected and processed using limited-bandwidth interceptive techniques. For the new-generation accelerators, we are developing a multiple-measurement microstrip probe to obtain broadband beam data from inside a drift tube without perturbing the beam. The cylindrical probe's dimensions are 6-cm OD by 1.0 m long, and the probe is mounted inside a drift tube. The probe (and its associated electronics) monitors bunched-beam current, energy, and transverse position by sensing the beam's electromagnetic fields through the annular opening in the drift tube. The electrical impedance is tightly controlled through the full length of the probe and transmission lines to maintain beam-induced signal fidelity. The probe's small, cylindrical structure is matched to beam-bunch characteristics at specific beamline locations so that signal-to-noise ratios are optimized. Surrounding the probe, a mechanical structure attaches to the drift-tube interior and the quadrupole magnets; thus, the entire assembly's mechanical and electrical centers can be aligned and calibrated with respect to the rest of the linac.

34642 (LA-UR—86-1718) **Precision alignment of permanent-magnet drift tubes.** Liska, D.J.; Dauelsberg, L.B.; Spalek, G. (Los Alamos National Lab., NM (USA)). 1986. Contract W-7405-ENG-36. 3p. (CONF-860629—6). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011214.

From Linear accelerator conference; Stanford, CA, USA (2 Jun 1986).

The Lawrence Berkeley National Laboratory (LBNL) technique of drift-tube alignment has been resurrected at Los Alamos for the precision alignment of 1-cm-bore drift tubes that carry high-gradient rare-earth-cobalt quadrupole. Because the quadrupole cannot be switched off, this technique is not applicable to a drift-tube assembly, but tests indicate that individual magnetic centers can be detected with a precision of +- 0.003 mm. Methods of transferring this information to machined alignment flats on the

sides of the drift-tube body are discussed. With measurements of drift tubes designed for a 100-mA. 425-MHz drift-tube linac, we have detected offsets between the geometric and magnetic axes of up to +- 0.05 mm following final assembly and welding. This degree of offset is serious if not accommodated, because it represents the entire alignment tolerance for the 40-cell tank. The measurement equipment and technique are described.

34643 (LBL—20834-Rev.) Optical systems for synchrotron radiation. Lecture 2. Mirror systems. Howells, M.R. (Lawrence Berkeley Lab., CA (USA)). Feb 1986. Contract AC03-76SF00098. 26p. (CONF-8509255—1-Rev.). NTIS, PC A03/MF A01; GPO Dep. File Number DE86009951.

From Synchrotron radiation sources and their applications conference; Aberdeen, Scotland (14 Sep 1985).

The process of reflection of VUV and x-radiation is summarized. The functions of mirrors in synchrotron beamlines are described, which include deflection, filtration, power absorption, formation of a real image, focusing, and collimation. Fabrication of optical surfaces for synchrotron radiation beamlines are described, and include polishing of a near spherical surface as well as bending a cylindrical surface to toroidal shape. The imperfections present in mirrors, aberrations and surface figure inaccuracy, are discussed. Calculation of the thermal load of a mirror in a synchrotron radiation beam and the cooling of the mirror are covered briefly. 50 refs., 7 figs. (LEW)

34644 (NIKHEF-K-LINO—109) Accelerator-timing system. Timmer, E.; Heine, E. (Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie K). 1 Jul 1985. 36p. (In Dutch). NTIS (US Sales Only), PC A03/MF A01. File Number DE86702180.

Along the NIKHEF accelerator in Amsterdam (Netherlands), at several places a signal is needed for the sychronization of all devices with the acceleration process. In this report, basic principles and arrangements of this timing system are described.

34645 (SLAC/AP—44) Equivalent circuit analysis of sled. Lippmann, B.A. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). May 1986. Contract AC03-76SF00515. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011489.

A direct application of equivalent circuit concepts leads to: (1) confirmation of Perry Wilson's SLED (SLAC Linac Energy Doubler) equation; (2) an equation that applies to a SLED device with input and output waveguides of different characteristic impedances; and (3) an equation that results if we demand that no power be lost by reflection from SLED. If the incident voltage is tailored as prescribed by this equation, the cavity voltage tracks the incident voltage and the reflected voltage is zero.

34646 (SLAC-CN—328) Resolution of the arcs and linac BPM systems. Pellegrin, J.L. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). 12 May 1986. Contract AC03-76SF00515. 10p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86011145.

The resolution obtained with two types of beam position monitors, the Linac model and the arc model, with their respective electronics are compared. Below 10^{10} particles the Linac system yields a better resolution, but beyond 10^{10} the Arcs system exhibits a resolution which is inversely proportional to the signal-to-noise ratio. (LEW)

34647 (UCRL—93261) Electrical measurement techniques for pulsed high current electron beams. Struve, K.W. (Lawrence Livermore National Lab., CA (USA)). 1 Apr 1986. Contract W-7405-ENG-48. 10p. (CONF-860384—8). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010980.

From Conference on measurement of electrical quantities in pulse power systems-II; Gaithersburg, MD, USA (5 Mar 1986).

The advent of high current (1 to 100 kA), moderate energy (>10 MeV), short pulse (1 to 100 ns) electron accelerators used for charged particle beam research has motivated a need to complement standard diagnostics with development of new diagnostic techniques to measure electron beam parameters. A brief survey is given of the diagnostics for measuring beam current, position, size, energy, and emittance. While a broad scope of diagnostics will be discussed, this survey will emphasize diagnostics used on the Experimental Test Accelerator (ETA) and Advanced Test Accelerator (ATA). Focus is placed on diagnostics measuring beam current, position and size. Among the diagnostics discussed are resistive wall current monitors, B/sub θ/ loops, Rogowski coils, Faraday cups, and x-ray wire diagnostics. Operation at higher current levels also increases radiation and electromagnetic pulse interference. These difficulties and methods for circumventing them are also discussed.

34648 Electrostatic quadrupole focused particle accelerating assembly with laminar flow beam. Maschke, A. W. (to The United States of America as represented by the United States Department of Energy). US Patent 4,560,905. 24 Dec 1985. Filed date 16 Apr 1984. vp.

PAT-APPL-600645.

A charged particle accelerating assembly provided with a predetermined ratio of parametric structural characteristics and with related operating voltages applied to each of its linearly spaced focusing and accelerating quadrupoles, thereby to maintain a particle beam traversing the electrostatic fields of the quadrupoles in the assembly in an essentially laminar flow throughout the assembly.

34649 How does an XUV-Initiated ion source work?. Sweeney, M.A.; Woodworth, J.R.; Maenchen, J.E. (Sandia National Labs., Albuquerque, NM). pp 2R-5 of IEEE conference record-abstracts of the 1985 IEEE international conference on plasma science. Piscataway, NJ; IEEE Service Center (1985). (CONF-850699—). Contract AC04-76DP00789.

From Conference on plasma sciences; Pittsburgh, PA, USA (3 Jun 1985).

XUV spark sources are being used on PBFA-I to improve turn-on time and plasma source uniformity of carnauba wax-filled grooved anodes. Carnauba wax is composed chiefly of ceryl palmitate, $C_{26}H_{51}COOC_{30}H_{61}$, and has a melt temperature of about 360 K. The xuv spark sources illuminate the wax with 10 to 70 eV photons at a peak intensity of about 30 kW/cm^2 before the accelerator voltage arrives at the Applied-B diode. This illumination has produced a nearly constant 1-ohm impedance, a peak diode voltage of about 2.8 MV, and rapid initiation of the ion current. To determine whether an XUV source will be useful in providing lithium or carbon ions for light ion beam fusion,[2] we need to understand the nature of the mechanism that produces the anode turn-on. The mechanisms may involve photon-stimulated desorption and/or thermal desorption, instead of the electron-stimulated desorption that induces surface discharges in conventional passive flashover anodes. Moreover, the xuv radiation may preferentially remove weakly-bonded hydrocarbon contaminants (i.e., pump oil) from the anode surface. Analytical and numerical investigations of these two desorption mechanisms will be presented.

4304 Storage Rings

REFER ALSO TO CITATION(S) 34615, 34624

34650 (DESY—85-125) Derivation of the Derbenev-Kondratenko formula using semi-classical electrodynamics. Mane, S.R. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.); Cornell Univ., Ithaca, NY (USA). Dept. of Physics). Nov 1985. 33p. NTIS (US Sales Only), PC A03/MF A01. File Number DE86752056.

We present a detailed exposition of the mechanism for the build-up of polarization in electron storage rings. A semi-classical approach is used to derive the rate of growth and asymptotic degree of polarization in an electron storage ring (the Derbenev-Kondratenko formula). Statistical mechanical concepts used to obtain as classical an understanding as possible of this phenomenon.

34651 (DESY—85-128) HERA variable-energy 'mini' spin rotator and head-on ep collision scheme with choice of electron helicity. Buon, J.; Steffen, K. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.); Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire). Oct 1985. 39p. NTIS (US Sales Only), PC A03/MF A01. File Number DE86752054.

The novel scheme of spin rotation and head-on collision in the HERA electron-proton collider is described with emphasis on the means for obtaining a high degree of longitudinal electron polarization of either sign at the interaction points. The variable-energy 'mini' rotator employed in this scheme is described and discussed, and also the depolarizing effect of radiative spin diffusion and the means to counteract it. The designed scheme covers the whole range of electron energies between 27 and 35 GeV, with a maximum degree of Sokolov-Ternov polarization of 84% at 35 GeV.

44 INSTRUMENTATION

4401 Radiation Instrumentation

REFER ALSO TO CITATION(S) 33785, 33796, 33866, 34038, 34627, 34688, 34793, 34825, 34888, 34940

34652 (CERN-EP—86-36) Modular multidrift vertex detector. Bouclier, R.; Charpak, G.; Gao, W.; Peisert, A.; Santiard, J.C.; Sauli, F.; Solomey, N. (European Organization for Nuclear Research, Geneva (Switzerland)). 20 Mar 1986. 15p. (CONF-860272—8). NTIS, PC A02/MF A01. File Number DE86901425.

From Wire chamber conference; Vienna, Austria (25 Feb 1986).

Several 80 cm long multiwire drift tubes have been built and tested each with 128 independent drift cells consisting of individual anodes centered in a hexagonal cell, 1 mm in radius, defined by six cathode wires. A thin hexagonal carbon-fiber envelope supports the wire tension and provides gas tightness. Charged tracks are measured recording drift times on all anodes, on an average ten times on each module; the longitudinal coordinate can be measured from current division at the two ends of each wire. Several modules can be packed to build a compact, fast vertex detector suitable for collider experiments. 5 refs., 7 figs.

34653 (CERN-EP—86-40) Will gaseous detectors survive the rapid progress in the competing techniques. Charpak, G. (European Organization for Nuclear Research, Geneva (Switzerland)). 26 Mar 1986. 10p. (CONF-860272—10). NTIS (US Sales Only), PC A02/MF A01. File Number DE86901426.

From Wire chamber conference; Vienna, Austria (25 Feb 1986).

The possibilities of further progress in gaseous detectors are illustrated based on examples from the activity at CERN. Amplification of avalanches between parallel grids in single or multistep structure is discussed. Use of multistep avalanch chambers for VUV detectors and x-ray imaging based on that amplification is discussed. Use of dense scintillators with gaseous detectors is reported. Optical imaging of avalanches and electrostatic imaging are also discussed briefly. The tracking of particle trajectories is examined. 17 refs., 3 figs. (LEW)

34654 (CONF-860272—9) Induction driftchamber. Roderburg, E.; Baecker, A.; Krieger, H.; Mattern, D.; Walenta, A.H.; Zech, G. (Siegen Univ. (Gesamthochschule) (Germany, F.R.). Fachbereich 11 - Maschinentechnik 1). 1986. 29p. NTIS (US Sales Only), PC A03/MF A01. File Number DE86901423.

From Wire chamber conference; Vienna, Austria (25 Feb 1986).

A new type of a drift chamber, the induction drift chamber (IDC) is described. It combines the capability of resolving high counting rates and good spatial resolution. The optimization for high counting rates is achieved by narrow spaced anode - potential - wires (the size of a sensitive cell is 600 μm). The high spatial resolution is obtained by using the difference of induced signals on potential wires. Test measurements resulted in a resolution of $\sigma = 26$ μm. The limit of this resolution was given by signal to noise ratio. Further investigations showed that it can be improved with other gases to $\sigma = 10$ μm. 16 refs., 14 figs.

34655 (EML—446) KLERUS: an energy independent gamma survey meter. Latner, N.; Watnick, S.; Negro, V.C.; Graveson, R.T. (Department of Energy, New York (USA). Environmental Measurements Lab.). Oct 1985. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011332.

A sensitive, portable survey instrument that measures gamma and x-ray radiation is described. It uses a dual phosphor detector which allows an instrument response independent of energy. With a lower limit of detectability significantly less than natural background, it is particularly useful for low level survey measurements.

34656 (FNAL-TM—1382) Cerenkov counter design for a high energy, high intensity secondary beam. Borcherding, F.O. (Fermi National Accelerator Lab., Batavia, IL (USA)). Apr 1986. Contract AC02-76CH03000. 38p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86011589.

A cerenkov counter design is given for operation in a 500 GeV/c secondary beam with 10^9 to 10^{11} particles per 1 millisecond spill. The design allows the fractions of pions, kaons and protons to be determined. In particular the fraction of kaons should be measured with a relative accuracy of a few percent.

34657 (INIS-BR—461, pp 21-23) **Analysis of neutron spectra with NE 213 detectors.** Antunes, L.J.; Boerker, G.; Klein, H. (Instituto de Engenharia Nuclear, Rio de Janeiro, Brazil. Dept. de Fisica; Physikalisch-Technische Bundesanstalt, Braunschweig, Germany, F.R.). 1984. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. File Number DE86702106.

In Annual technical report of Nuclear Engineering Institute - Physics Department - 1984.

34658 (INIS-BR—461, pp 64-68) **Mounting of a time spectrometer to measure the positron life time for studying damage irradiation.** Santos, G.R. dos; Goncalves, Z.C. 1984. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. File Number DE86702106.

In Annual technical report of Nuclear Engineering Institute - Physics Department - 1984.

34659 (INIS-BR—461, pp 68-71) **Preliminary results of life time measurements for positrons to study the irradiation damage.** Santos, G.R. dos; Goncalves, Z.C. 1984. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. File Number DE86702106.

In Annual technical report of Nuclear Engineering Institute - Physics Department - 1984.

34660 (INIS-BR—461, pp 72-76) **Mapping of a ^{137}Cs open source.** Suita, J.C.; Silva, A.G. da; Auler, L.T.; Vinagre Filho, U.M. 1984. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. File Number DE86702106.

In Annual technical report of Nuclear Engineering Institute - Physics Department - 1984.

34661 (INIS-BR—461, pp 76-77) **Efficiency of a High Purity Germanium detector.** Cabral, S.C. 1984. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. File Number DE86702106.

In Annual technical report of Nuclear Engineering Institute - Physics Department - 1984.

34662 (INIS-BR—461, pp 11-13) **Calibration of NE-213 detectors.** Suita, J.C.; Auler, L.T.; Silva, A.G. da; Silva, A.A. da. 1984. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. File Number DE86702106.

In Annual technical report of Nuclear Engineering Institute - Physics Department - 1984.

34683 (INIS-BR—461, pp 14-18) **Neutron-gamma discrimination of NE-213 detector.** Suita, J.C.; Silva, A.G. da; Silva, A.A. da; Antunes, L.J.; Auler, L.T. 1984. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. File Number DE86702106.

In Annual technical report of Nuclear Engineering Institute - Physics Department - 1984.

34684 (INIS-BR—461, pp 24-30) **Fission chambers for neutron beams monitoring.** Brandao, L.E.B.; Auler, L.T.; Silva, A.G. da. 1984. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. File Number DE86702106.

In Annual technical report of Nuclear Engineering Institute - Physics Department - 1984.

34685 (INIS-mf—10107) **Nuclear instrumentation.** Hajek, B. (ed.). (Ceskoslovenska Komise pro Atomovou Energii, Prague). Dec 1984. 56p. (In Czech). NTIS (US Sales Only), PC A04/MF A01. File Number DE86702194.

Normalizace v jaderne technice. (No. 5).

The standardization of nuclear instrumentation is the responsibility of the TESLA Research Institute for Nuclear Instrumentation (VUPJT) in Premysleni. CMEA-issued standards are given which have been developed by the Institute and the themes of the complex plan for the years 1981-1985 are listed. In 1983 the Institute was granted the status of a branch standardization centre. The basic provisions and main tasks are given. The amended draft of CMEA standard "Gas-filled ionization detectors" is presented listing the main parameters and dimensions of the detectors, technical requirements and testing methods. Also presented is the amended draft of CMEA standard "Scintillation detection units" containing requirements on the design and resistance of the units against mechanical effects, parameters, testing methods, packing, transport and storage standards.

34686 (INIS-mf—10111, pp 13) **Application of Monte Carlo Method in correcting the matrix effect in determinations of natural radionuclides in ores using semiconductor gamma spectrometry.** Bouda, T. (Ceskoslovensky Uranovy Prumysl, Straz pod Ralskem. Ustredni Laboratore). May 1985. (In Czech). NTIS (US Sales Only), PC A03/MF A01. File Number DE86701997. (CONF-8505256—Absts.).

From IAA conference on instrumental activation analysis; Klucenice, Czechoslovakia (12 May 1985).

34687 (INIS-mf—10111, pp 29) **Time dependence of efficiency of planar Ge detector spectrometer.** John, J. (Ceske Vysoke Uceni Technicke, Prague, Czechoslovakia. Fakulta Jaderna a Fysikalne Inzenyrska). May 1985. (In Czech). NTIS (US Sales Only), PC A03/MF A01. File Number DE86701997. (CONF-8505256—Absts.).

From IAA conference on instrumental activation analysis; Klucenice, Czechoslovakia (12 May 1985).

34688 (INIS-mf—10111, pp 10-12) **Experience with application of $Bi_4Ge_3O_{12}$ scintillation crystal in gamma detection.** Janout, Z.; Konicek, J.; Pospisil, S.; Vobecky, M.; Barta, C.; Gilar, O.; Pavlicek, Z. (Ceske Vysoke Uceni Technicke, Prague, Czechoslovakia. Fakulta Jaderna a Fysikalne Inzenyrska; Ceskoslovenska Akademie Ved, Prague. Ustav Nuklearni Biologie a Radiochemie; Ceskoslovenska Akademie Ved, Prague. Fyzikalni Ustav; Tesla, Premysleni, Czechoslovakia. Vyzkumny Ustav Pristroju Jaderne Techniky). May 1985. (In Czech). NTIS (US Sales Only), PC A03/MF A01. File Number DE86701997. (CONF-8505256—Absts.).

From IAA conference on instrumental activation analysis; Klucenice, Czechoslovakia (12 May 1985).

34689 (INIS-mf—10111, pp 23) **Calibration of gamma spectrometry monitors for radiation control in nuclear power engineering.** Kapisovsky, V.; Bena, J.; Zeman, J. (Vyskumny Ustav Jadrovych Elektrarni, Jaslovske Bohunice, Czechoslovakia). May 1985. (In Slovak). NTIS (US Sales Only), PC A03/MF A01. File Number DE86701997. (CONF-8505256—Absts.).

From IAA conference on instrumental activation analysis; Klucenice, Czechoslovakia (12 May 1985).

34690 (INIS-mf—10111, pp 26) **Portable system for detection of heavy charged particles.** Pospisil, S.; Hirsl, P.; Janout, Z.; Konicek, J.; Fukatko, T.; Jursik, J. (Ceskoslovenska Akademie Ved, Prague. Ustav Organicke Chemie a Biochemie; Kovosluzba, Prague, Czechoslovakia). May 1985. (In Czech). NTIS (US Sales Only), PC A03/MF A01. File Number DE86701997. (CONF-8505256—Absts.).

From IAA conference on instrumental activation analysis; Klucenice, Czechoslovakia (12 May 1985).

34691 (INIS-mf—10112) **Dose and dose rate monitor.** Novakova, O.; Ryba, J.; Slezak, V.; Svobodova, B.; Viererbl, L. (Tesla, Premysleni (Czechoslovakia). Vyzkumny Ustav Pristroju Jaderne Techniky). Oct 1984. 120p. (In Czech). NTIS (US Sales Only), PC A06/MF A01. File Number DE86702191.

The methods are discussed of measuring dose rate or dose using a scintillation counter. A plastic scintillator based on polystyrene with PBD and POPOP activators and coated with ZnS(Ag) was chosen for the projected monitor. The scintillators were cylindrical and spherical in shape and of different sizes; black polypropylene tubes were chosen as the best case for the probes. For the counter with different plastic scintillators, the statistical error 2σ for natural background was determined. For determining the suitable thickness of the ZnS(Ag) layer the energy dependence of the counter was measured. Radioisotopes ^{137}Cs, ^{241}Am and ^{109}Cd were chosen as radiation sources. The best suited ZnS(Ag) thickness was found to be 0.5 μm. Experiments were carried out to determine the directional dependence of the detector response and the signal to noise ratio. The temperature dependence of the detector response and its compensation were studied, as were the time stability and fatigue manifestations of the photomultiplier. The design of a laboratory prototype of a dose rate and dose monitor is described. Block diagrams are given of the various functional parts of the instrument. The designed instrument is easiiy portable, battery powered, measures dose rates from natural background in the range of five orders, i.e., 10^{-3} to 10^{3} nGy/s, and allows to determine a dose of up to 10 mGy. Accuracy of measurement in the energy range of 50 keV to 1 MeV is better than +-20%.

34692 (ITEP—32(1985)) **Uranium gas sampling calorimeter.** Arefiev, A.; Galaktionov, Yu.; Gordeev, A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1985. 24p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86702193.

A gas sampling calorimeter with uranium absorbers was built and tested in a beam of pions and electrons of 1 to 6 GeV/A. No difference between uranium and conventional absorber is found as far as the detection of electromagnetic showers is concerned. The measured π/e ratio is 0.83 +- 0.03. A peculiar energy dependence of resolution of the calorimeter for hadron is discussed.

34693 (RAL—86-007) **Aleph electromagnetic calorimeter.** Edwards, M. (Rutherford Appleton Lab., Chilton (UK)). Jan 1986. 25p. (CONF-8510308—2). Rutherford Appleton Lab., Chilton, Didcot, Oxon, 0X11 0QX England. File Number TI86901310.

From Gas sampling calorimetry workshop; Batavia, IL, USA (31 Oct 1985).

Following a brief outline of the ALEPH detector the electromagnetic calorimeter is described. A number of selected parts of the calorimeter are discussed in detail and solutions to problems encountered given. Some results obtained using prototype calorimeters in a CERN test beam are reported.

34694 **Resolution of pulsed-source small-angle neutron scattering.** Seeger, P.A.; Pynn, R. (Los Alamos National Lab., NM, USA; Institut Max von Laue - Paul Langevin, 38 - Grenoble, France). *Nuclear Instruments and Methods in Physics Research;* **245**: No. 1, 115-124(15 Apr 1986).

An analytic form is found for resolution of small-angle scattering in a plane, at a pulsed source with a white neutron spectrum. The function is found to be asymmetric at low values of Q and to have broad tails if data recorded over the entire wavelength range are combined. Monte Carlo calculations in three dimensions and including realistic spectra and collimator geometry confirm these features and provide "data" for studying the question of what regions of scattering angle and wavelength should be retained in data reduction. Comparisons are made with a spectrometer at a reactor, based on the accuracy, statistical precision, and time required to collect data for (simulated) monodisperse hard spheres of various radii. (orig.).

34675 **Doppler filter technique to measure the hydrogen content of planetary surfaces.** Feldman, W.C.; Drake, D.M. (Los Alamos National Lab., NM, USA). *Nuclear Instruments and Methods in Physics Research;* **245**: No. 1, 182-190(15 Apr 1986).

A new technique to measure the hydrogen content of planetary surfaces is suggested. It relies on the Doppler energy shift of planetary albedo neutrons in the frame of a planar neutron sensor aboard a low-altitude orbiting spacecraft. It can be realized by a small modification to the current design of the anticoincidence shield enclosing a possible Mars Observer gamma-ray spectrometer. The resultant sensitivity to hydrogen near the surface of the Moon is estimated to be nearly three orders of magnitude greater than the sensitivity inherent in the detection of 2.223 MeV neutron capture γ-rays by the spectrometer. (orig.).

34676 **Hadron showers and muon trajectories in thick absorber from 25 to 150 GeV/c.** Green, D.; Fenker, H.; Martin, P.; Takasaki, M.; Yamada, R.; Kunori, S.; Rapp, P.; Owen, D.; Grannis, P.; Hedin, D. (Fermi National Accelerator Lab., Batavia, IL, USA; Maryland Univ., College Park, USA; Michigan State Univ., East Lansing, USA; State Univ. of New York, Stony Brook, USA). *Nuclear Instruments and Methods in Physics Research;* **244**: No. 3, 356-366(1 Apr 1986).

Hadron shower punchthrough and muon momentum measurements were conducted at 25, 50, 100 and 150 GeV/c, using tracking before, between and after a 7.3 interaction length (lambda$_0$) lead block and 7.3 lambda$_0$ of magnetized iron. The multiplicity and spatial distributions of both hadrons and muons were obtained. Muons were used to study the multiple scattering, the effect of delta rays and associated phenomena, and the momentum resolution. Hadrons were used to study the muon/hadron rejection factor. The measured punchthrough probabilities after 7.3 lambda$_0$ and 14.6 lambda$_0$ were consistent with other data. Cuts are described which define the final rejection factor against hadrons. (orig.).

34677 **The development and testing of a silicon trigger detector with 400 elements for the HELIOS (NA 34) experiment.** Beuttenmuller, R.; Kraner, H.W.; Ludlam, T.W.; Polychronakos, V.A.; Van Dijik, J.; Radeka, V.; Chesi, E.; Piuz, F.; Tschulik, A.; Esten, M.J. (Brookhaven National Laboratory, Upton, NY 11973-5000). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-33**: No. 2, 1045-1050(Apr 1986).

A 30 mm diameter, 300 μ thick silicon detector has been constructed for the basic trigger element in the NA34 (HELIOS) experiment at CERN. It contains 400 discrete active junction detectors ("pads") which are connected to 400 low-noise hybrid preamplifiers giving 500 - 700 rms electrons noise level. Results of tests in spatially well-defined particle beams will be presented which verify the efficiency of each pad and its effective charge collection area.

34678 **Improvements in the energy resolution and high-count-rate performance of bismuth germanate.** Koehler, P.E.; Wender, S.A.; Kapustinsky, J.S. (Los Alamos National Lab., NM, USA). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **242**: No. 3, 369-372(15 Jan 1986). (CONF-850533—).

From 6. symposium on X- and gamma-ray sources and applications; Ann Arbor, MI, USA (21 May 1985).

Also published as report LA-UR--85-1299; CONF-850533--3.

Several methods for improving the energy resolution of bismuth germanate (BGO) have been investigated. It is shown that some of these methods resulted in a substantial improvement in the energy resolution. In addition, a method to improve the performance of BGO at high counting rates has been systematically studied. The results of this study are presented and discussed.

34679 **Si(Li)-NaI(Tl) sandwich detector array for measurements of trace radionuclides in soil samples.** Strauss, M.G.; Sherman, I.S.; Roche, C.T.; Pehl, R.H. (Argonne National Lab., IL, USA; Lawrence Berkeley Lab., CA, USA). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **242**: No. 3, 387-394(15 Jan 1986). (CONF-850533—).

From 6. symposium on X- and gamma-ray sources and applications; Ann Arbor, MI, USA (21 May 1985).

Also published as CONF-850533--10.

An ultra-sensitive X/γ-ray detector system for assaying trace radioactivity in actinide contaminated soil and ash samples has been developed. The new system consists of an array of 6 large Si(Li) X-ray detectors sensitive on both faces and mounted on edge in a paddle-shaped cryostat with a 14 cm diameter Be window on each side. The paddle, with a sample of the soil placed at each window, is sandwiched between 2 large NaI(Tl) scintillators which suppress the γ background. With X-rays being measured simultaneously from soil in 2 sample holders and background reduced by 50% using anticoincidence, the sensitivity of this detector is 4 times higher than that of conventionally mounted Si(Li) detectors. A soil sample containing 50 pCi/g ^{239}Pu was measured in 5 min with an uncertainty of $<$20% and a sample containing 7 pCi/g was measured in 1 h. With fwhm resolution of 400 eV at 17 keV, the ULβ_1 and NpLsub(β1) X-ray peaks are resolved thus permitting measurement of trace Pu in the presence of ^{241}Am. This is the most sensitive and selective detector known for nondestructive assay of radioactivity in soil and other samples.

34680 **Bismuth germanate scintillators: Applications in nuclear safeguards and health physics.** Moss, C.E.; Dowdy, E.J.; Lucas, M.C. (Los Alamos National Lab., NM, USA). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **242**: No. 3, 480-483(15 Jan 1986). (CONF-850533—).

From 6. symposium on X- and gamma-ray sources and applications; Ann Arbor, MI, USA (21 May 1985).

Also published as report LA-UR--85-1477; CONF-850533--2.

Bismuth germanate (BGO) scintillators are preferable to NaI(Tl) scintillators or germanium detectors for some applications. We describe two systems based on BGO scintillators for applications in nuclear safeguards and health physics. The first system, which consists of eight scintillators and a computer-based data acquisition system, is very efficient. The second, which consists of one scintillator and a small analyzer, is less efficient but portable. A computer code that uses measured response functions and photopeak efficiencies, unfolds the BGO distributions measured with these systems to determine gamma-ray flux spectra and dose rates. One application of these systems is the accurate determination of flux spectra and dose rates from containers of uranium or plutonium. A second application determined these quantities from a replica of Little Boy, the device exploded over Hiroshima.

34681 **High sensitivity alpha-particle and electron spectroscopy.** Ahmad, I. (Argonne National Lab., IL, USA. Chemistry Div.). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **242**: No. 3, 395-398(15 Jan 1986). (CONF-850533—).

From 6. symposium on X- and gamma-ray sources and applications; Ann Arbor, MI, USA (21 May 1985).

Thin massless sources of ^{238}Pu and ^{249}Cf, prepared in an electromagnetic isotope separator, have been used to determine the characteristics of newly developed passivated ion implanted silicon detectors. These detectors are found to be superior to the usual Au-Si surface barrier detectors, both in resolution and peak tailing. For

^{238}Pu α-groups we have measured a resolution (fwhm) of (9.2 +- 0.2) keV and find the tail to be 1.0 x 10^{-5} of the peak height. This tailing is more than an order of magnitude better than that obtained with the best surface barrier detectors. Relative intensities of ^{249}Cf α-groups have also been measured with high precision.

34682 **Nuclide activities determined from γ-ray spectra from Ge detectors: A review with GAUSS VIII as the example.** Helmer, R.G.; Putnam, M.H.; McCullagh, C.M. (Idaho National Engineering Lab., Idaho Falls, USA). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **242**: No. 3, 427-436(15 Jan 1986). (CONF-850533—).

From 6. symposium on X- and gamma-ray sources and applications; Ann Arbor, MI, USA (21 May 1985).

This review will describe the various features that are useful in a general-purpose computer program to analyze γ-spectra from Ge detectors. An INEL code, GAUSS VIII, is used as an example of such a program. This discussion assumes that the goal of the analysis is to determine the activities of the nuclides present for a number of spectra (i.e., production analysis) and that no specialized treatment is given to any particular spectrum. In order to analyze a γ-ray spectrum in this way, one needs to carry out the following four general functions: (1) calibration of peak energies and widths; (2) a first analysis of spectrum to determine the energies and areas of the peaks and the nuclides that may be present; (3) a second analysis of spectrum to determine the areas of the stronger peaks associated with the identified nuclides but that were not found in the first spectral analysis; and (4) nuclide activity calculations. Some desirable features related to these four areas are discussed.

34683 **On-line gamma-ray data acquisition at the Power Burst Facility.** Hartwell, J.K.; Killian, E.W. (Idaho National Engineering Lab., Idaho Falls, USA). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **242**: No. 3, 487-492(15 Jan 1986). (CONF-850533—).

From 6. symposium on X- and gamma-ray sources and applications; Ann Arbor, MI, USA (21 May 1985).

A key component in the monitoring of fission product release tests in the Power Burst Facility (PBF) at the Idaho National Engineering Laboratory is the fission product detection system (FPDS). This system incorporates four high-resolution, germanium gamma-ray spectrometers that operate in real time. These spectrometers, monitoring the effluent produced when a fuel rod test bundle is severely damaged, measure the magnitude and timing of fission product release. Fission product concentrations are measured at four locations along the PBF sampling system to provide transport data. Two computers, located a kilometer from the two processors that perform the spectrometer function, control and monitor system operation. The FPDS incorporates several unique features designed to respond to the requirements of monitoring a severe fuel damage test or severe accident condition in a nuclear power plant. Included are a high-rate analog electronics package, a variable collimator system, and a unique pulser-based system performance monitor. The system has operated during four PBF severe fuel damage tests, some of which have generated sample line radiation fields of nearly 900 R/h. Using the on-line spectral data accumulated, fission product release rates for a variety of nuclides have been quantified.

34684 **Fundamental study on an electret dosimeter for a surface contamination monitor.** Uda, T.; Ohtsuka, H.; Ozawa, Y. (Hitachi ERL, Ibaraki, Japan). *Transactions of the American Nuclear Society;* **50**: 433(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

To develop a convenient and sensitive surface contamination monitoring system, the feasibilities of an electret dosimeter using a thin polymer electret and piezoelectret sensor have been examined. To reduce the amounts of radioactive wastes, major interest has recently turned to the low-level radioactive wastes for which the contamination level is less than the de minimis level, which allows treatment as reusable waste. While official de minimis levels have not been set, average levels are presumed to be 10^{-6} and 10^{-4} μCi/g for alpha and gamma contamination, respectively. The regulatory unit is the weight of radioactivity, but alpha contamination cannot be measured without a surface value. So the authors examined a surface contamination monitor, which was particularly suited to alpha measurements. Although electret dosimeters have been developed of the ion chamber type, the electret dosimeter using only a polymer foil was investigated.

34685 **New unfolding code for a multisphere neutron spectrometer.** Chang, D.; Levine, S.H. (Univ. of Missouri, Columbia). *Transactions of the American Nuclear Society;* **50**: 435-436(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

Accurate measurements of neutron doses in the containment of a commercial nuclear power plant have been a concern in the last several years. If neutron dosimeters are used to assess exposures in a spectral environment substantially different from that in which they were calibrated, the dose equivalent interpretation of these dosimeters can be an order of magnitude higher than the actual dose. Proper characterization of the spectral environment will provide proper corrections for the reading. Many computer programs have been written for unfolding the spectrum with the measured count rates. A new unfolding computer code has been devised based on the response function calculated from a neutron transport code for 25 neutron energy groups from thermal to 15 MeV.

34686 **Spectrometer gun.** Waechter, D.A.; Umbarger, C.J.; Wolf, M.A. (to Dept. of Energy). US Patent 4,550,381. 29 Oct 1985. Filed date 3 Nov 1981. vp.

PAT-APPL-317816.

A hand-holdable, battery-operated, microprocessor-based spectrometer gun includes a low-power matrix display and sufficient memory to permit both real-time observation and extended analysis of detected radiation pulses. Universality of the incorporated signal processing circuitry permits operation with various detectors having differing pulse detection and sensitivity parameters.

4402 Radiation Effects On Instrument Components, Instruments, Or Electronic Systems

REFER ALSO TO CITATION(S) 34348

34687 **(AD-A—164124/0/XAB) Radiation effects of high-energy electrons upon thermionic integrated circuits. Master's thesis.** Arguello, W.R. (Naval Postgraduate School, Monterey, CA (USA)). Dec 1985. 74p. NTIS, PC A04/MF A01.

Thermionic Integrated Circuit (TIC) devices use a hybrid of vacuum tube and integrated circuit technology. The integrated circuitry is fabricated on a sapphire (AL_2O_3) substrate. A device was irradiated to attempt to establish a total dose (measured in rad Si) of radiation to cause the TIC device to malfunction. The TIC device was irradiated using 30- and 100-MeV electrons provided by the Naval Postgraduate School Linear Accelerator (LINAC). The device received a total dose of 1.8155 x 10^9 rad Si during the course of the experiments. It continued to function normally through the irradiation study, so it is concluded that the device is not sensitive to radiation, at least at the levels used.

34688 **(AD-A—164413/7/XAB) InP:Fe and GaAs:Cr picosecond photoconductive radiation detectors. Master's thesis.** Keipper, P.J. (Naval Postgraduate School, Monterey, CA (USA)). Dec 1985. 123p. NTIS, PC A06/MF A01.

The dark-current, impulse, and square-pulse response measurements of photoconductive devices fabricated from two different types of materials, gallium arsenide with chromium dopant (GaAs:r) and indium phosphide with iron dopant (InP:Fe) are reported. These devices have been subjected to irradiation from the S-band electron linear accelerator (LINAC) with an energy fo 100 MeV at room temperature. Fluence ranged between 10^{13} and 10^{16} electrons/sq cm. Dark/current decreases with increasing fluence for the GaAs:Cr devices whereas InP:Fe shows an increase in the dark current. Both types of materials exhibit extremely fast impulse response after the irradiation. Electron mobility, drift velocity, and response speed decrease with increasing fluence. Response speeds of < 100 ps are achieved by fast-carrier relaxation in the semicon-

ductor due to the introduction of trapping and recombination centers resulting from the irradiation damage. The GaAs:Cr, unlike the InP:Fe, more closely follows the longer square-pulse exhibiting non nonlinearity. All results are consistent with previously investigated neutron irradiated devices.

34689 **(AD-A—164520/9/XAB) Electron irradiation of n-channel silicon on sapphire-insulated-gate field-effect transistors (IGFET). Master's thesis.** Pornaras, R.A. (Naval Postgraduate School, Monterey, CA (USA)). Dec 1985. 111p. NTIS, PC A06/MF A01.

SOS, n-channel, insulated gate field effect transistors (IGFETs) were irradiated at room temperature wht a 30-MeV electron beam at doses from 104 to 106 rads (Si). The effects of the irradiation on IGFET performance were evaluated by measuring threshold voltage decreased after each irradiation, up to the highest dose. The threshold voltage behavior was as expected for an n-channel IGFET undergoing gate oxide charge build-up. The total dose was not large enough to exhibit threshold voltage increases indicative of interface state generation. The IGFETs were allowed to anneal for 107 hours at room temperture. The threshold voltage recovered to approximately 65% of its pre-irradiation value within thirty hours. It then increased slowly to about 75% of its pre-irradiation value by the end of the observed annealing time. Threshold voltage rebound was not observed.

34690 **(SAND—86-0280C) Total-dose and annealing studies - implications for hardness assurance testing.** Winokur, P.S.; Sexton, F.W.; Schwank, J.R.; Fleetwood, D.M. (Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 6p. (CONF-860706—5). NTIS, PC A02/MF A01; GPO Dep. File Number DE86006464.

From 23. annual conference on nuclear and space radiation effects; Providence, RI, USA (20 Jul 1986).

A series of experiments on CMOS devices covering a wide range of dose rate, bias, and annealing conditions is described. These experiments provide a technical basis for making recommendations in support of improved steady-state total-dose irradiation procedures.

34691 **(SAND—86-0308C) Interface-state generation in polysilicon gate devices.** Schwank, J.R.; Winokur, P.S.; Sexton, F.W.; Fleetwood, D.M.; Perry, J.H.; Dressendorfer, P.V.; Turpin, D.C. (Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 5p. (CONF-860706—3). NTIS, PC A02/MF A01; GPO Dep. File Number DE86006459.

From 23. annual conference on nuclear and space radiation effects; Providence, RI, USA (20 Jul 1986).

The time dependence of interface-state generation in polysilicon gate MOS devices has been investigated. Interface-states have been detected milliseconds after irradiation, indicating more than one mechanism may be responsible for interface-state generation.

34692 **(SAND—86-0309C) Dose enhancement of low energy radiation.** Fleetwood, D.M.; Winokur, P.S.; Lorence, L.J. Jr.; Beezhold, W.; Schwank, J.R. (Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 5p. (CONF-860706—6). NTIS, PC A02/MF A01; GPO Dep. File Number DE86006463.

From 23. annual conference on nuclear and space radiation effects; Providence, RI, USA (20 Jul 1986).

MOS capacitors were irradiated with 10-keV X rays through a reversible gold/aluminum bilaminate. The observed relative dose enhancement depended on the oxide thickness in an unexpected way. Possible implications for VLSI device response are discussed.

34693 **(SAND—86-0448C) Improved transient ionizing-radiation survivability of n-channel power MOSFETs.** Dawes, W.R. Jr.; Fischer, T.A.; Huang, C.C.C.; Meyer, W.J.; Smith, C.S.; Blanchard, R.A.; Fortier, T.J. (Sandia National Labs., Albuquerque, NM (USA); MA/COM PHI, Inc., Torrance, CA (USA); Siliconix, Inc., Santa Clara, CA (USA)). 1986. Contract AC04-76DP00789. 4p. (CONF-860706—11). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86007700.

From 23. annual conference on nuclear and space radiation effects; Providence, RI, USA (20 Jul 1986).

Substantial improvements have been made in the fabrication of medium-power, n-channel MOSFETs permitting operation at dose rates up to 1 x 10^{12} rad(Si)/s. The physical mechanisms responsible for power MOSFET burnout are discussed along with the fabrication techniques used in the improved designs.

4403 Miscellaneous Instruments

REFER ALSO TO CITATION(S) 34011

34694 **(BNL—38000) Modifications of commercial oxides of nitrogen detectors for improved response.** Kelly, T.J. (Brookhaven National Lab., Upton, NY (USA)). Mar 1986. Contract AC02-76CH00016. 60p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86010536.

This report describes modifications made to commercially available chemiluminescent oxides of nitrogen (NO/sub x/) detectors to improve their sensitivity, to obtain accurate detector zero readings, and to allow measurement of gaseous nitric acid. Modifications to both a Thermo-Electron 14-B and a Monitor Labs 8840 detector are reported; drawings of modified reaction chambers for both detectors are provided. The theory of NO/sub x/ detector operation and modification is briefly discussed, and modifications and original designs developed previously are cited. The report presents examples of data obtained with the modified detectors, and experience with the detectors in NO/sub x/ and HNO_3 measurements both at the ground and on board aircraft is described. In addition, brief operator's manuals for both modified detectors are included as appendices to this report.

34695 **(GAT-T—3376) Contaminant monitor (an improved line recorder).** Barbarits, F.S. (Goodyear Atomic Corp., Piketon, OH (USA)). 25 Apr 1986. Contract AC05-76OR00001. 50p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86010944.

It has been apparent for many years that the Line Recorders (specialized mass spectrometers) were becoming increasingly more inaccurate and unreliable. The age of this equipment, the unavailability of spare parts and key personnel changes have all contributed. A long-range project undertaken to study the problems and design an improved line recorder consisted of three major phases. In the first phase, a microprocessor based controller was built and then interfaced to the existing hardware. This improved the accuracy of the system because now continuous automatic readjustments could be made to peak the instrument's performance; a task presently performed by the L.R. mechanics. Hardware and software was also installed which enabled the implementation of a near operator-free calibration. Automating the system in this way not only improved accuracy but also alleviated this burden on the L.R. mechanic. In addition to these changes, significant improvements were made in the display and recording of data to enhance the operational efficiency of the system. Although many problems were addressed in this first phase, a major problem remained. A suitable replacement for the ailing magnetic sector mass spectrometer was needed. The second phase of the project resulted in a favorable evaluation of a quadrupole mass spectrometer which met both the cost and performance requirements. The final phase integrated this quadrupole with the microprocessor-based controller to form a prototype "contaminant monitor". This totally new instrument provides a significant improvement in accuracy and reliability over the existing line recorders. An on-line evaluation has concluded that this system is also easier to operate and maintain.

34696 **(INIS-mf—10105, pp 90) New type of NMR spectrometer from TESLA Brno - BS 587.** 1984. NTIS (US Sales Only), PC A02/MF A01. File Number DE86702155. (CONF-8406249—Vol.2-Absts.).

From 7. Czechoslovak spectroscopic conference and 8. CANAS; Ceske Budejovice, Czechoslovkia (18 Jun 1984).

34697 (INIS-mf—10111, pp 30) **Application possibilities in activation analysis of gamma spectrometry system Nuclear Data with PDP 11/34A computer.** Obrusnik, I.; Horak, Z.; Kucera, J. (Ustav Jaderneho Vyzkumu CSKAE, Rez, Czechoslovakia). May 1985. (In Czech). NTIS (US Sales Only), PC A03/MF A01. File Number DE86701997. (CONF-8505256—Absts.).

From IAA conference on instrumental activation analysis; Klucenice, Czechoslovakia (12 May 1985).

34698 **(LA-UR—86-1617) Sphericity measurements of full spheres using subaperture optical testing techniques.** Day, R.D.; Beery, T.A.; Lawrence, G.N. (Los Alamos National Lab., NM (USA); Applied Optics Research, Albuquerque, NM (USA)). 1986. Contract W-7405-ENG-36. 9p. (CONF-860620—2). NTIS, PC A02. File Number DE86011255.

From Society of Photo-Optical Instrumentation Engineers international symposium: topics in optical and optoelectronic applied sciences and engineering; Quebec City, Canada (2 Jun 1986).

This paper discusses the progress being made on the development of applying subaperture interferometric testing techniques to making sphericity measurements on the entire surface of a full sphere.

34699 **(SAND—85-2099) Peak-power measurements using a peak-power ratio generator and a dual-channel, true-power-release power meter.** Moyer, R.B. (Sandia National Labs., Albuquerque, NM (USA)). May 1986. Contract AC04-76DP00789. 12p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86011545.

A signal-processing module permits peak-power measurements on a dual-channel, true-power-response power meter. Operation is based on the constant peak-power output of a hybrid analog/digital loop. The peak current of a tunnel diode serves as the high-bandwidth, stable-reference levels for the loop. Measurement accuracy is +0, -0.35 dB for pulse widths of ≧6.7 ns and pulse repetition frequencies up to 75 MHz. Basic measurement range is from +10 to +36 dBm. Calibration is in terms of a known continuous-wave signal - typically +10 dBm.

34700 **(SAND—86-0358C) Filter-fluorescer measurement of low-voltage simulator x-ray energy spectra.** Baldwin, G.T.; Craven, R.E. (Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 5p. (CONF-860706—8). NTIS, PC A02/MF A01; GPO Dep. File Number DE86007143.

From 23. annual conference on nuclear and space radiation effects; Providence, RI, USA (20 Jul 1986).

X-ray energy spectra of the Maxwell Laboratories MBS and Physics International Pulserad 737 were measured using an eight-channel filter-fluorescer array. The PHOSCAT computer code was used to calculate channel response functions, and the UFO code to unfold spectrum.

34701 **(UCID—20760) Analysis of elastic-plastic resistance material response for stress gage design.** Stout, R.B. (Lawrence Livermore National Lab., CA (USA)). Apr 1986. Contract W-7405-ENG-48. 45p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86010777.

A deformation dependent model is developed for the resistivity changes of materials. The resistance response is represented as a functional that depends on measures of relative deformation between atoms and on dislocation density. Deformation dependent mechanisms of intrinsic resistivity are changes in the electronic band configurations, changes in the electron-phonon interaction cross-sections, and changes in the density of defect structures. The deformation dependent model for electronic band configurations is to represent changes in the number density of mobile electrons. The deformation dependent model for electron-phonon interaction and the density of defect structures is to represent changes in the scattering mechanisms that impede electron transport through a material. It is only after intrinsic resistivity is formulated in terms of recoverable and nonrecoverable deformation measures that a portion of a materials' resistance change can be isolated and explicitly identified as stress tensor dependent. This stress dependent part of the intrinsic resistivity response is referred to as the "idealized" piezoresistivity of a material. This idealized piezoresistivity is the change that depends on recoverable strains, which in the idealized case are elastic. In order to analyze and design reliable stress gages it is necessary to understand this idealized piezoresistance response, as well as other recoverable and nonrecoverable deformation dependent contributions to resistivity. Finally, an analysis is presented to demonstrate that a resistivity measurement for a single piezoresistance foil gage is not uniquely related to only one stress tensor applied to the gage. This analysis sugggests a new design for a triple material piezoresistance gage package to provide three independent and simultaneous resistivity measurements that are uniquely related to the three normal components of the stress tensor.

34702 **(UCRL—93783) Use of gas imaging as a means of locating leaks and tracking gas clouds.** McRae, T.; Stahovec, J. (Lawrence Livermore National Lab., CA (USA); Naval Sea Systems Command, Washington, DC (USA). Office of Salvage and Diving). Apr 1986. Contract W-7405-ENG-48. 20p. (CONF-860447—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010786.

From American Institute of Chemical Engineers spring national meeting; New Orleans, LA, USA (6 Apr 1986).

A new concept for the detection and tracking of toxic or flammable gases resulting from accidental spills or leaks is presented. The Backscatter/Absorption Gas Imaging (BAGI) technique is based on the optical radiation augmentation of the field of view of an imaging device by laser radiation corresponding to an absorption line of the gas species to be detected. The laser power requirements are greatly reduced by synchronizing the unexpanded laser beam with the raster-like, scanning field of view of a flying-spot imaging system. Several different configurations of possible BAGI systems are presented. In addition, a list of detectability limits for toxic and flammable materials that absorb carbon dioxide (CO_2) laser radiation is included. The current status and future plans of the NAVSEA BAGI development program are explained.

34703 **Rigid indented cylindrical cathode for x-ray tube.** Hudgens, C. R. (to The United States of America as represented by the Department of Energy). US Patent 4,560,897. 24 Dec 1985. Filed date 6 Jun 1983. vp.

PAT-APPL-501312.

A cathode assembly for a vacuum tube includes a wire filament, a straight tubular anode parallel to and surrounding the wire filament, and insulating spacers for rigidly fastening the filament with respect to the anode, and with one side of the anode indented or flattened such that only one portion of the anode is heated to emitting temperatures by the filament.

34704 **Method and apparatus for determining pressure-induced frequency-shifts in shock-compressed materials.** Moore, D. S.; Schmidt, S. C. (to The United States of America as represented by the United States Department of Energy). US Patent 4,555,176. 26 Nov 1985. Filed date 16 Dec 1983. vp.

PAT-APPL-562150.

A method and an apparatus for conducting coherent anti-Stokes Raman scattering spectroscopy in shock-compressed materials are disclosed. The apparatus includes a sample vessel having an optically transparent wall and an opposing optically reflective wall. Two coherent laser beams, a pump beam and a broadband Stokes beam, are directed through the window and focused on a portion of the sample. In the preferred embodiment, a projectile is fired from a high-pressure gas gun to impact the outside of the reflective wall, generating a planar shock wave which travels through the sample toward the window. The pump and Stokes beams result in the emission from the shock-compressed sample of a coherent anti-Stokes beam, which is emitted toward the approaching reflective wall of the vessel and reflected back through the window. The anti-Stokes beam is folded into a spectrometer for frequency analysis. The results of such analysis are useful for determining chemical and physical phenomena which occur during the shock-compression of the sample.

34705 **Backscatter absorption gas imaging system.** McRae Jr., T. G. (to The United States of America as represented by the United States Department of Energy). US Patent 4,555,627. 26 Nov 1985. Filed date 5 Apr 1983. vp.
PAT-APPL-482380.

A video imaging system for detecting hazardous gas leaks. Visual displays of invisible gas clouds are produced by radiation augmentation of the field of view of an imaging device by radiation corresponding to an absorption line of the gas to be detected. The field of view of an imager is irradiated by a laser. The imager receives both backscattered laser light and background radiation. When a detectable gas is present, the backscattered laser light is highly attenuated, producing a region of contrast or shadow on the image. A flying spot imaging system is utilized to synchronously irradiate and scan the area to lower laser power requirements. The imager signal is processed to produce a video display.

34706 **Method and apparatus for measuring response time.** Johanson, E.W.; August, C. (to Dept. of Energy). US Patent 4,548,513. 22 Oct 1985. Filed date 11 Aug 1983. vp.
PAT-APPL-522282.

A method of measuring the response time of an electrical instrument which generates an output signal in response to the application of a specified input, wherein the output signal varies as a function of time and when subjected to a step input approaches a steady-state value, comprises the steps of: applying a step input of predetermined value to the electrical instrument to generate an output signal; simultaneously starting a timer; comparing the output signal to a reference signal to generate a stop signal when the output signal is substantially equal to the reference signal, the reference signal being a specified percentage of the steady-state value of the output signal corresponding to the predetermined value of the step input; and applying the stop signal when generated to stop the timer.

34707 **Peak power ratio generator.** Moyer, R.D. (to Dept. of Energy). US Patent 4,546,313. 8 Oct 1985. Filed date 14 Mar 1983. vp.
PAT-APPL-474997.

A peak power ratio generator is described for measuring, in combination with a conventional power meter, the peak power level of extremely narrow pulses in the gigahertz radio frequency bands. The present invention in a preferred embodiment utilizes a tunnel diode and a back diode combination in a detector circuit as the only high speed elements. The high speed tunnel diode provides a bistable signal and serves as a memory device of the input pulses for the remaining, slower components. A hybrid digital and analog loop maintains the peak power level of a reference channel at a known amount. Thus, by measuring the average power levels of the reference signal and the source signal, the peak power level of the source signal can be determined.

34708 **Thermoluminescence dosimeter.** Zendle, R. (to Dept. of Energy). US Patent 4,546,259. 8 Oct 1985. Filed date 3 Nov 1983. vp.
PAT-APPL-548278.

A thermoluminescence dosimeter having a very small rate of decline of sensitivity during subsequent uses after heating is disclosed. The dosimeter includes a detector crystal and a glass enclosure in which the detector crystal is located. The glass enclosure is air tight and is filled with a super dry inert fill gas. The inert fill gas in nonreactive with the detector crystal when the detector crystal is heated to thermoluminescence. The fill gas is selected from the group consisting of air, nitrogen, and argon, suitable admixed with 5 to 25 percent helium. The detector crystal consists essentially of calcium fluoride. The fill gas is preferably contained at a subatmospheric pressure in the glass enclosure.

34709 **Void/particulate detector.** Clayton, T. N.; Karplus, H. B. (to The United States of America as represented by the United States Department of Energy). US Patent 4,542,644. 24 Sep 1985. Filed date 26 Sep 1983. vp.
PAT-APPL-535979.

Voids and particulates are detected in a flowing stream of fluid contained in a pipe by a detector which includes three transducdrs spaced about the pipe. A first transducer at a first location on the pipe transmits an ultrasonic signal into the stream. A second transducer detects the through-transmission of the signal at a second location and a third transducer at a third location upstream from the first location detects the back-scattering of the signal from any voids or particulates. To differentiate between voids and particulates a fourth transducer is positioned at a fourth location which is also upstream from the first location. The back-scattered signals are normalized with the through-transmission signal to minimize temperature fluctuations.

34710 **Ultra-sensitive isotopic analysis by resonance ionization mass spectrometry.** Donohue, D.L.; Christie, W.H.; Goeringer, D.E.; McKown, H.S. (Analytical Chemistry Div., Oak Ridge National Lab., Oak Ridge, TN 37831). pp 395-301 of Lasers '84. McLean, VA; STS Press (1984). (CONF-8411153—). Contract AC05-84OR21400.

From International conference on lasers '84; San Francisco, CA, USA (26 Nov 1984).

A high-powered pulsed dye laser has been interfaced to a commercial ion microprobe mass analyzer. This combination should provide ultra-high sensitivity for isotope ratio measurements of selected elements in environmental samples. The technique is an outgrowth of resonance ionization mass spectrometry which has demonstrated high precision for isotope ratio determinations of uranium and plutonium using thermal filament atomization. Sputter atomization using a pulsed argon ion beam represents a significant improvement in efficiency because the temporal overlap between the atom cloud and the laser pulse can approach 100%. This, coupled with the high ionization efficiency of laser induced resonance ionization methods, promises an analytical sensitivity which is significantly better than other microprobe techniques. A description of the experimental set-up is given along with the modifications to the ion microprobe instrument which were necessary to obtain acceptable ion extraction efficiency. Also shown are results for samarium and uranium demonstrating the optical and mass spectra obtained.

34711 **Investigation of decalibrated Nicrosil versus Nisil thermocouples: quantitative SIMS analysis using indexed sensitivity factors and oxygen flooding.** Christie, W.H.; Eby, R.E.; Anderson, R.L.; Kollie, T.G. (Oak Ridge National Lab., TN). *Applications of Surface Science;* **18**: 287-298(1984). Contract W-7405-ENG-26.

Secondary Ion Mass Spectrometry was used to determine the failure mode of sheathed Nicrosil versus Nisil thermocouples exposed to temperatures above 1000°C. Four thermocouples, two sheathed in Inconel-600 and two sheathed in type 304 stainless steel, were studied. Relative sensitivity factors, indexed by a matrix ion species ratio, were used to quantify SIMS data for the alloys studied. Oxygen pressure $\geq 2.7 \times 10^{-4}$ Pa in the sputtering region gave enhanced sensitivity and superior quantitative results compared to data obtained at instrument residual pressure. At sufficiently high oxygen surface coverage, the slope of the nonlinear sensitivity factor curves for the Nicrosil and Nisil alloys approached zero. Quantified SIMS data showed that these thermocouples decalibrated because significant alterations in the elemental composition of the Nicrosil and Nisil thermoelements occurred. The extent of the observed alteration was different for each thermocouple, for a given time and temperature of exposures, and was influenced by the particular sheath material used in the thermocouple construction. 7 references, 5 figures, 3 tables.

34712 **Deformation stages and video installation for a Phillips EM400T.** Horton, J.A. (Oak Ridge National Lab., TN). *Proceedings - Annual Meeting, Electron Microsopy Society of America;* **40**: 748-749(1982). Contract W-7405-ENG-26.

A series of specimen stages for a Phillips EM400T AEM have been constructed in order to conduct deformation and fracture experiments inside the microscope. The stages were built primarily of beryllium copper to ensure no residual magnetism. In addition to ambient temperature stages, a low temperature deformation stage was constructed. One control system which depends on a differentially threaded screw operated by hand is discussed. The hydraulic control system which allows either a constant load or a cyclic load to be applied to the specimen is diagrammed. 4 figures.

4404 Well Logging Instrumentation

REFER ALSO TO CITATION(S) 33939

34713 (PB—86-150133/XAB) Borehole probe for in-situ neutron activation analysis. Open File report, 28 September 1976-1 August 1980. Baicker, J.A.; Lister, D.B.; Marr, R.E.; Goldman, L.H. (Princeton Gamma-Tech, Inc., NJ (USA)). Jun 1984. 120p. NTIS, PC A06/MF A01.

A prototype borehole probe for ore-grade determinations by means of in-situ neutron activation analysis was designed, built, and tested in a two-phase program. Phase I dealt with the design and fabrication of a borehole logging system for operation in 7.6 cm (3 in.) diameter or larger boreholes. In phase II, the system was field tested at several minesites. The system was calibrated, tested, improved, and demonstrated in a variety of applications.

45 EXPLOSIONS AND EXPLOSIVES

4501 Chemical

34714 (SAND—85-2787C) Shock sensitivity of TiH/sub 0.65/$KClO_4$. Headley, P.S.; Bickes, R.W. Jr. (Unidynamics/Phoenix, Inc., AZ (USA); Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 9p. (CONF-860739—10). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010990.

From 11. international pyrotechnics seminar; Vail, CO, USA (7 Jul 1986).

The pyrotechnic TiH/sub 0.65/$KClO_4$ (THKP) is shock initiated in a through-bulkhead actuator (TBA) manufactured at Unidynamics. In the testing of various lots of THKP, we observed an apparent lot-to-lot variability in the shock sensitivities of the powders. The shock sensitivity for each powder lot was obtained by firing fifty TBA units each specially machined with a different bulkhead thickness. These powder lot qualification tests were both expensive and time consuming. For those reasons, we developed a new sensitivity test that is less complicated, inexpensive and consumes less THKP powder. In addition, it has the advantage that we can now easily vary several powder parameters such as density, powder preparation and condition, powder mass and the diameter of the powder column. Our new test method consists of simultaneously shocking 20 simulated TBA units in a so-called shock board. The shock board contains the simulated TBAs around its periphery; the TBA simulators can have various bulkhead thicknesses and are easy to machine. The simulators are mounted at the ends of EXTEX tracks that are all fired at the same time by a detonator located at the center of the board. After firing the assembly, the units are checked for function and the data analyzed using the ASENT computer program. 8 refs., 3 figs., 1 tab.

34715 (SAND—85-2788C) Thermal ignition of TiH/sub 1.68/$KClO_4$. Bickes, R.W. Jr. (Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 11p. (CONF-860739—9). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010991.

From 11. international pyrotechnics seminar; Vail, CO, USA (7 Jul 1986).

Many explosive components are ignited using the thermal pulse produced by passing a low current through a small metal bridgewire which has explosive powder pressed against it. A quantitative description to aid the component designer of these so-called hot-wire devices that includes ignition and powder burn does not yet exist. Therefore, we began to carefully examine ignition as a function of the explosive powder type and those physical parameters that the component engineer can adjust in the development of a new device. Using a 300-watt, cw, Nd-YAG laser, we rapidly heated a test fixture into which the pyrotechnic powder, TiH/sub 1.68/$KClO_4$, was pressed. We measured the time to ignition as a function of the applied heat flux, the mass of the explosive powder and powder density. The experimental scheme was statistically designed and the data analyzed by a multilinear regression model. For lower laser power values the ignition times were (almost) independent of powder mass. However, for high laser power values (greater than 120 watts) the ignition time vs powder mass regression surface had a maximum at 22.5 mg of powder (near the mid-range of weights tested). 10 refs., 4 figs., 2 tabs.

34716 (SAND—85-2813C) DDT performance of energetic cobalt coordination compounds. Lieberman, M.L.; Fleming, W. (Sandia National Labs., Albuquerque, NM (USA); Unidynamics/Phoenix, Inc., AZ (USA)). 1986. Contract AC04-76DP00789. 16p. (CONF-860739—8). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010996.

From 11. international pyrotechnics seminar; Vail, CO, USA (7 Jul 1986).

The compound 2-(5-cyanotetrazolato)pentaamminecobalt(III) perchlorate (CP) has been utilized in low-voltage detonators because it reliably undergoes deflagration-to-detonation transition (DDT). In the present investigation, we have compared the performance of over a dozen similar compounds. These compounds all have cobalt as the coordinating metal, most are ammine complexes, and all except one incorporate the perchlorate anion as an oxidizer. Chemical factors such as fuel-to-oxidizer ratio, trigger group, and organic content have been varied. 18 refs., 7 figs., 2 tabs.

34717 (UCID—20737) Study on the rheology of RX-08-FK LLNL's paste explosive. von Holtz, E. (Lawrence Livermore National Lab., CA (USA)). Apr 1986. Contract W-7405-ENG-48. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86010781.

Understanding the rheological properties of paste explosives (PEX) is vital to utilizing this technology in any application. We recently completed testing our current paste candidate, RX-08-FK. This PEX exhibited non-Newtonian flow properties, and could be analyzed via use of power law curves. Neglecting yield stress, the PEX data followed power law behavior, with the exponents (n) being in the region of 0.3 to 0.6 (expected region was 0.35 to 0.65). This classifies the PEX as having strongly pseudoplastic behavior (decreasing apparent viscosity with increasing shear rate). Using information extracted from this data, we were able to conclude that pressure transfer of this material from one configuration to another is a highly feasible concept. We estimate that to transfer 60 lb of our PEX through 4 feet of 1 inch ID tubing at 50°F, we would need a driving pressure of only 500 psi to accomplish the extrusion in less than 20 seconds. 2 figs., 4 tabs.

34718 Explosives synthesis at Los Alamos. Coburn, M.D.; Harris, B.W.; Lee, K.Y.; Stinecipher, M.M.; Hayden, H.H. (Explosives Technology, Los Alamos National Laboratory, Los Alamos, NM 87545). *Industrial and Engineering Chemistry, Product Research and Development;* **25**: No. 1, vp(Mar 1986).

During the past two decades, the explosives synthetic effort at Los Alamos has been directed toward energetic heterocylic compounds and has produced some useful thermally stable explosives. The recent evolution of crystal-density predictive methods is guiding our current efforts toward ultrahigh performance explosives. Much of our effort is now on the development of new methods for preparing unique nitro compounds that are inaccessible by conventional techniques. This paper reviews the Los Alamos synthetic program with emphasis on the development of novel thermally stable explosives, and current efforts to synthesize high-density/performance explosives will be discussed.

34719 Ethylenediamine salt of 5-nitrotetrazole and preparation. Lee, K.Y.; Coburn, M.D. (to Dept. of Energy, Washington, DC). US Patent 4,552,598. 12 Nov 1985. Filed date 17 May 1984. vp.

PAT-APPL-611557.

Ethylenediamine salt of 5-nitrotetrazole and preparation are disclosed. This salt has been found to be useful as an explosive alone and in eutectic mixtures with ammonium nitrate and/or other explosive compounds. Its eutectic with ammonium nitrate has been demonstrated to behave in a similar manner to a monomolecular explosive such as TNT, and is less sensitive than the pure salt. Moreover, this eutectic mixture, which contains 87.8 mol % of ammonium nitrate, is close to the CO_2-balanced composition of 90 mol %, and has a relatively low melting point of 110.5 C making it readily castable. The ternary eutectic system containing the ethylenedia-

mine salt of 5-nitrotetrazole, ammonium nitrate and ethylenediamine dinitrate has a eutectic temperature of 89.5 C and gives a measured detonation pressure of 24.8 GPa, which is 97.6% of the calculated value. Both the pure ethylenediamine salt and its known eutectic compounds behave in substantially ideal manner. Methods for the preparation of the salt are described.

34720 **Preparation of ethylenediamine dinitrate.** Lee, K. Y. (to The United States of America as represented by the United States Department of Energy). US Patent 4,539,430. 3 Sep 1985. Filed date 17 May 1984. vp.

PAT-APPL-611558.

Method for the preparation of ethylenediamine dinitrate. Ethylenediamine dinitrate, a useful explosive, may readily be prepared by solvent extraction of nitrate ion from an acidic aqueous solution thereof using a high-molecular-weight, water-insoluble amine dissolved in an organic solvent, and reacting the resulting organic solution with ethylenediamine. The process of the instant invention avoids the use of concentrated nitric acid, as is currently practiced, resulting in a synthesis which is far less hazardous especially for large quantities of the explosive, and more efficient.

34721 **The relationship between the shock sensitivity and the solid pore sizes of TATB powders pressed to various densities.** Lee, R.; VonHolle, W.; Bloom, G.; Sanders, S.; Slettevold, C.; McGuire, R. (Dept. of Physics, Kansas State Univ., Manhattan, KS 66506). pp 38/4-38/5 of Proceedings of the international symposium workshop on particulate and multi-phase processes. Ariman, T.; Veziroglu, T.N. Coral Gables, FL; Clean Energy Research Institute (1985). (CONF-850406—).

From International symposium and workshop on particulate and multi-phase processes and the 16th annual meeting of the Fine Particle Society; Miami Beach, FL, USA (22 Apr 1985).

Shock initiation of pressed secondary high explosives is due to concentration of energy at inhomogenieties in the material, leading to localized "hot spots" and subsequent reaction. The level of stimulus required to initiate a detonation is a strong function of the density to which the explosive is pressed. In addition, the stimulus required depends on the particle size distribution of the powder from which the explosive specimens are pressed. Internal voids in the high explosive sample provide several mechanisms by which shock energy may be concentrated. Proposed mechanisms include plastic work, formation of microjets and shocks generated by void collapse. Mercury intrusion porosimetry provides a method for directly investigating voids in a pressed sample. The authors have made mercury intrusion porosimetry measurements on pressed samples of TATB (triaminotrinitrobenzene) for three, quite-different particle size distributions pressed to densities ranging from 73-99% of theoretical maximum density. They also measured the shock stimulus required to initiate a detonation in the same materials.

4502 Nuclear

REFER ALSO TO CITATION(S) 34778

34722 **(AD-A—163695/0/XAB) Electromagnetic pulse - the fifth factor in the impact of a nuclear explosion.** (Air Force Systems Command, Wright-Patterson AFB, OH (USA). Foreign Technology Div.). 16 Jan 1986. 33p. (FTD-ID(RS)T—1176-85). NTIS, PC A03/MF A01.

Three ionization zones form during high-altitude nuclear explosions: 1) a short-lived ionization zone in the area of the nuclear explosion; 2) radioactive cloud hovering over the center of the explosion. The cloud consists of ionized volatile products from the explosion and lingers for several hours or even days; and 3) a large zone of increased ionization resulting from gamma and x-ray radiation as well as from neutrons. The zone forms at an altitude of 40 to 70 kilometers and remains for several days. Increased ionization zones have an impact on radio wave propagation and interfere with radio communication as well as the operation of radar stations. Radiation emitted from the increased ionization zone can have an impact on changing the parameters of elements in electronic devices, especially semiconductors. This can in turn interfere with the operation of other equipment, including radio stations, radars, and infrared telescopes, and can also damage this equipment.

34723 **(UCRL—15760) Effects of condensation on steam flow and hydraulic fracture propagation in permeable media.** Nilson, R.H. (S-Cubed, La Jolla, CA (USA)). Oct 1985. Contract W-7405-ENG-48. 68p. (SSS-R—85-7145). NTIS, PC A04/MF A01; GPO Dep. File Number DE86008150.

A review of analytical, numerical, and experimental work on condensing flow in porous media indicates that the primary effect of condensation is the large, typically ten-fold, reduction in penetration depth associated with the collapse of the vapor. As a result, the pressure gradient is about ten-fold larger and, hence, the mass flow rate into the medium is ten-fold greater than it would be in an isothermal gas flow, despite the formation of a liquid plug at the leading edge of the condensing flow. The ten-fold increase in mass flow rate into the permeable surface is equivalent to a hundred-fold increase in the effective permeability. These observations are supported by analytical arguments, comparison with detailed numerical calculations, and by comparison with experimental data from four independent sources. Order of magnitude estimates indicate that in typical nuclear testing applications these basic features of a condensing flow should not be substantially influenced by nonDarcy inertial effects and that heat conduction and capillarity should have a negligible influence so long as the permeability is greater than 0.1 milliDarcy.

4503 Explosion Detection

34724 **(CONF-810310—3) Seismic event detection using adaptive predictors.** Stearns, S.D.; Vortman, L.J. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86009488.

From IEEE international conference on acoustics, speech and signal processing; Atlanta, GA, USA (30 Mar 1981).

Adaptive digital predictors have been applied to the detection of seismic events. In this paper we review the structure of the adaptive predictor and discuss its implementation. Using seismic velocity data, we then demonstrate its ability to locate signal arrivals.

34725 **(UCRL—15810) Knowledge representation techniques for seismic signal understanding.** (Technicom International Corp., Falls Church, VA (USA)). Mar 1986. Contract W-7405-ENG-48. 47p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86010553.

Seismic monitoring and discrimination of seismic events for purposes of nuclear test ban verification require the interpretation of large volumes of uncertain signal data by seismic experts. Several levels of knowledge representation are envisioned to make the transduction from raw signal data to the level of symbolic representation used to represent knowledge by AI techniques. At the lower level, techniques drawn from the feature based approach to speech recognition and syntactic pattern recognition address primitive features and segmentation into symbolic units of syntax which apply to various representations or transforms of the seismic signal, such as seismograms. At a higher level, conventional knowledge representation schemes and new algebraic approaches to knowledge representation based on algebraic systems are considered as they might apply to representations of the signal established by the lower level techniques. This report defines and outlines these techniques as well as describes how they are likely to be successfully integrated into a unified approach for representing knowledge in seismic signals for symbolic signal processing. The report also recommends further steps and directions the research should take and includes a preliminary bibliography covering both theoretical and applied aspects of the knowledge representation techniques discussed. (ACR)

50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC

5001 Basic Studies

REFER ALSO TO CITATION(S) 34145, 34411, 34795

34726 **(DOE/ER/60106—4) Lake ice occurrence as an early detector of climate perturbations: the potential for monitoring. Progress report, March 1985-March 1986.** Barry, R.G. (Colorado Univ., Boulder (USA). Cooperative Inst. for Research in Environmental Sciences). 4 Apr 1986. Contract AC02-83ER60106. 10p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86010583.

Studies of lake ice freeze-up/break-up dates as a proxy for estimating transition season temperatures over data-sparse areas were continued. Previous analyses were extended to the records available for Finland. The practicality of monitoring lake ice conditions routinely using operational meteorological satellite data was assessed. (ACR)

34727 **(DOE/EV/10083—T2) Engineering, Instrumentation, Systems Integration and Flight Support for Balloon Operations. Final technical report.** (New Mexico State Univ., Las Cruces (USA). Physical Science Lab.). 14 Mar 1984. Contract AI01-76EV10083. 22p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86010387.

The major objective of this work effort was to collect particulate and gaseous samples in the stratosphere by integrating electrical and mechanical hardware into a balloon-borne sampling system. PSL also launched the system into the stratosphere, collected the desired samples, recovered the system, reduced the data, and prepared summary flight reports.

34728 **(UCRL—93068) Application of multimedia pollutant transport models to risk analysis.** McKone, T.E.; Kastenberg, W.E. (Lawrence Livermore National Lab., CA (USA); California Univ., Los Angeles (USA). Dept. of Mechanical, Aerospace and Nuclear Engineering). 1986. Contract W-7405-ENG-48. 28p. (CONF-860156—2). NTIS, PC A03/MF A01; GPO Dep. File Number DE86010157.

From 1. workshop on pollutant transport and accumulation in a multimedia environment; Los Angeles, CA, USA (22 Jan 1986).

This paper will explore how multimedia models can be used in an environmental health risk analysis. The purpose of risk analysis is to assess and manage the adverse consequences of human activities. Multimedia models offer a way of organizing information about landscape and chemical properties in order to provide a comprehensive picture of the link between source and receptor for toxic chemicals. We begin with an overview of the risk-analysis process, including risk assessment and management. This is followed by a description of a multimedia model, called GEOTOX, which was developed for use in evaluating the health risks of trace elements, radionuclides, and organic chemicals. The model uses landscape properties such as run-off, precipitation, evaporation, biomass density, and soil properties and chemical properties such as molecular weight, vapor pressure, and solubility to determine how a substance partitions within the environment. The predicted environmental concentrations are used with exposure models and combined with health-effects data to estimate the potential human health risks associated with a given source. We demonstrate the use of GEOTOX by a sample application to three chemicals. We examine how these models can be used in risk assessment to better define the relationship between contaminant releases and resulting doses to humans. We also examine how these models can provide risk managers and decision makers with a means for determining the value of reducing uncertainties about chemical and landscape properties.

34729 **(UCRL—94388) Example of emergency response model evaluation of studies using the Mathew/Adpic models.** Dickerson, M.H.; Lange, R. (Lawrence Livermore National Lab., CA (USA)). Apr 1986. Contract W-7405-ENG-48. 17p. (CONF-860606—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86009400.

From Air Pollution Control Association annual meeting and exhibition; Minneapolis, MN, USA (22 Jun 1986).

This report summarizes model evaluation studies conducted for the MATHEW/ADPIC transport and diffusion models during the past ten years. These models support the US Department of Energy Atmospheric Release Advisory Capability, an emergency response service for atmospheric releases of nuclear material. Field studies involving tracer releases used in these studies cover a broad range of meteorology, terrain and tracer release heights, the three most important aspects of estimating air concentration values resulting from airborne releases of toxic material. Results of these studies show that these models can estimate air concentration values within a factor of 2 20% to 50% of the time and a factor of 5 40% to 80% of the time. As the meterology and terrain become more complex and the release height of the tracer is increased, the accuracy of the model calculations degrades. This band of uncertainty appears to correctly represent the capability of these models at this time. A method for estimating angular uncertainty in the model calculations is described and used to suggest alternative methods for evaluating emergency response models.

34730 **Systematic analysis of climatic model sensitivity to parameters and processes.** Hall, M.C.G.; Cacuci, D.G. (Oak Ridge National Lab., TN). pp 171-179 of Climate processes and climate sensitivity. Washington, DC; American Geophysical Union (1984). Contract W-7405-ENG-26.

This paper demonstrates the adjoint method of sensitivity analysis on a radiative-convective climate model with a diurnal cycle. A single adjoint calculation, which requires about the same computation time as the original model, suffices to calculate sensitivities of average surface air temperature of small variations in the model parameters. Relative sensitivities rank the importance of all the parameters, the most important parameters being those that characterize solar radiation and determine transmission functions. The uncertainties in the model results are expressed formally in terms of all the sensitivities and parameter covariances. For this model, a 10% standard deviation in surface albedo causes the increase in average surface air temperature after doubling CO_2 to have a standard deviation of 0.24 K about the expected value of 1.66 K. For results that cannot readily be compared with observation (for example, the results of a CO_2 doubling experiment), this method of uncertainty analysis is the only systematic way to estimate the reliability of model results. The radiative-convective model contains complex on-off nonlinear processes of the type found in general circulation models. Therefore, the fact that the adjoint method works successfully and efficiently for the radiative-convective model provides valuable information about subsequent application of the method to general circulation models. 12 references, 3 tables.

5002 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 33557, 33592, 33593, 33594, 33595, 33596, 33599, 33601, 33602, 33603, 33604, 33605, 33606, 33607, 33608, 33609, 33610, 33611, 33612, 33613, 33614, 33615, 33618, 33620, 33621, 33622, 33624, 33626, 33629, 33719, 33958, 33959, 33960, 34145, 34244, 34246, 34256, 34257, 34806, 34854, 34945, 34946

34731 **(BNL—37950) Case study of materials damage due to air pollution and acid rain in New Haven, CT.** Lipfert, F.W.; Dupuis, L.R.; Malone, R.G.; Schaedler, J.; daum, M.L. (Brookhaven National Lab., Upton, NY (USA)). May 1985. Contract AC02-76CH00016. 42p. (CONF-8505106—2). NTIS, PC A03/MF A01; GPO Dep. File Number DE86010546.

From 2. US-Dutch international symposium on aerosols; Williamsburg, VA, USA (19 May 1985).

This case study of New Haven, CT has estimated the annual costs of materials degradation due to SO_2 and acidic precipitation, at current conditions. The assessment is based on a detailed materials distribution, computed as well as measured environmental conditions, and newly-derived damage functions. Painted surfaces are the most prevalent, and contribute over 60% of the total estimated costs. Since paint damage is highly dependent on the type of paint and its application, these costs are less certain than, for example, the metal or stone damage portions. This finding emphasizes the

need for accelerated research on damage to painted surfaces due to acidic deposition. By pollutant, hydrogen ion deposition is seen to be responsible for more damage in New Haven than SO_2, for all materials. This finding, together with the important role played by background SO_2, indicated that regional air pollution is much more important for materials damage (in New Haven) than are local sources. This may not be the case, however, in a more industralized location.

34732 **(BNL—37958) Distribution of materials in place.** Daum, M.L.; Lipfert, F.W.; Oden, N.L. (Brookhaven National Lab., Upton, NY (USA)). Jun 1986. Contract AC02-76CH00016. 23p. (CONF-860606—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010539.

From Air Pollution Control Association annual meeting and exhibition; Minneapolis, MN, USA (22 Jun 1986).

A data base of amounts and locations of common building materials was developed from a field sample of 1058 buildings in four metropolitan areas in the northeastern United States. Sample strata were defined in terms of combinations of land use and population density called sampling frames. Sample units were quadrats of varying sizes, depending on the assignment of a quadrat to a particular sampling frame. Within-city and between-city extrapolations were to be based on the ratio of amounts of materials to land area units. Building counts proved more reliable, however, and therefore materials distributions were described instead on the basis of individual buildings. Extrapolations were based on estimated numbers of buildings of different types, on estimated total surface areas for each building typebuilding type, and on materials splits for each according to region. A correction factor was applied to corporate building counts and areas as a function of total metropolitan population. Sampling frame designations are still incorporated, however, since they are fundamental to the extrapolation equations for corporate building counts. In addition they proved necessary to the field survey process to insure coverage of all types of buildings in a given metropolitan area.

34733 **(CONF-860447—3) Simultaneous NO/sub x//SO/sub x/ removal in aqueous scrubber chemistries.** Harkness, J.B.L.; Doctor, R.D. (Argonne National Lab., IL (USA)). Apr 1986. Contract W-31-109-ENG-38. 40p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86010524.

From American Institute of Chemical Engineers spring national meeting; New Orleans, LA, USA (6 Apr 1986).

Using a laboratory-scale scrubber, seven metal-chelate additives were evaluated in terms of NO/sub x/ removal activity in lime and dual alkali scrubber chemistries. Stable forms of Fe(II)*EDTA (Ethylenediaminetetracetic acid) provided 70% nitric oxide removal, and other chelating agents matched the EDTA performance. Aluminum complexes gave the best performance, with more than 90% nitric oxide removal.

34734 **(DOE/NBB—0077) Impact of climate change from increased atmospheric carbon dioxide on American Agriculture.** Decker, W.L.; Jones, V.K.; Achutuni, R. (Missouri Univ., Columbia (USA). Dept. of Atmospheric Science). May 1986. Contract W-7405-ENG-48. 107p. NTIS, PC A06/MF A01; GPO Dep. File Number DE86010493.

This report discusses the state of agriculture in the US, including its historical development, its relationships with governmental policies and its economics. The impacts of CO_2-caused climate changes on agriculture are then considered, using corn as the example crop plant and cattle as the representative food animal. (ACR)

34735 **(DOE/PC/60264—T3) Development of a combined NO/sub x//SO_2 removal system based on ZnO scrubbing technology. Final report, 1 September 1983-30 September 1985.** Rosenberg, H.S.; Nuzum, H.K. (Battelle Columbus Labs., OH (USA)). Apr 1986. Contract AC22-83PC60264. 101p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE86009865.

This report describes the results of a laboratory study on the use of ZnO for combined removal of SO_2 and NO/sub x/ from flue gas. The laboratory study is the first phase in the development of a dry, regenerable flue gas cleaning process to remove at least 90% of the SO_2 and NO/sub x/ at lower cost than conventional systems. A fixed-bed reactor was used to determine reaction mechanisms, evaluate performance, identify important operating variables, and produce data for a conceptual process design. The conceptual design was used to assess the technical and economic feasibility of the process.

34736 (EPRI-CS—4390-Vol.2, pp 6.3-6.4) **Retrofit technology options for reducing sulfur emissions.** Katzberger, S.M. (Sargent & Lundy Engineers, Chicago, IL). Jan 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920170. (CONF-850630—Vol.2).

From 9. symposium on flue gas desulfurization; Cincinnati, OH, USA (4 Jun 1985).

A wide variety of technologies are available for reducing sulfur emissions from existing industrial and utility boilers. These technologies may reduce or capture sulfur: (1) prior to combustion through fuel switching, fuel blending, coal gasification, mechanical coal washing or chemical coal cleaning; (2) during combustion, as in furnace sorbent injection or fluidized bed boilers; or (3) after combustion, as in downstream sorbent injection, wet flue gas desulfurization (FGD) and spray drying. Each of these technologies has site specific advantages and disadvantages in terms of level of development, cost, retrofitability and sulfur reduction potential. Each technology should be reviewed to determine site-specific impacts on the existing plant. Retrofits typically require unit outages to existing plant equipment. Even fuel switching will require equipment modifications. Unit outage time should be considered in evaluating retrofit options. The costs and impacts of alternative retrofit technologies should be thoroughly reviewed to select the best technology for each site. The sensitivity of the total evaluated cost of each alternative to the remaining life of the unit may show that high capital cost technologies are not economically viable for older units without unit life extension. A mixture of retrofit technologies is available with the best choice in each case depending on the age and size of the unit and the sulfur reduction required.

34737 (EPRI-CS—4390-Vol.2, pp 9.125-9.137) **Comparison of pilot plant data with predictions from the US EPA SPRAYMOD computer program.** Davis, W.T.; Reed, G.D.; Partridge, G.P.; Brna, T.G. (Univ. of Tennessee, Knoxville). Jan 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920170. (CONF-850630—Vol.2).

From 9. symposium on flue gas desulfurization; Cincinnati, OH, USA (4 Jun 1985).

The use of computer models allows the user to predict conditions which may not have been tested in spray dryer/fabric filter applications. This paper presents a preliminary comparison of the US EPA developed SPRAYMOD computer program with a series of five different data bases collected at the University of Tennessee on a 1000 cfm spray dryer utilizing a $Ca(OH)_2$ slurry. Results are presented from a variety of operating conditions for the spray dryer without recycle, including: SO_2 concentration: 1000-3100 ppm; inlet temperature: 138°-177°C (280-350°F); approach to saturation (AT): 9°-20°C (16-35°F). Conclusions regarding the ability of the program to predict the actual behavior of the pilot plant are: (1) with the proper choice of a reaction rate coefficient, the plug flow model reliably predicted the performance for low SO_2 concentrations (1000-1100 ppm) and approaches to saturation in the range of 16-35°F, and (2) the model tended to overpredict performance for higher SO_2 concentrations (2000-3000 ppm). 5 references, 7 figures, 3 tables.

34738 (EPRI-CS—4390-Vol.2, pp 11.91-11.105) **Size measurements in aerosols produced in sulfur dioxide removal by electron beams.** Carabine, M.D.; Clay, P.G.; Sisniega, G. (Imperial College, London, England). Jan 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920170. (CONF-850630—Vol.2).

From 9. symposium on flue gas desulfurization; Cincinnati, OH, USA (4 Jun 1985).

Droplet size distributions have been measured in the sulfuric acid aerosols which were produced when electron beams or plasma discharges were applied to gas streams containing sulfur dioxide. For all the conditions investigated, the distributions were described

by zero order log normal functions, and the modal diameters were in the range 0.3 to 0.5 μm. Half-peak widths were never greater than 0.3 μm, and the ZOLD spread parameters (σ_9) were in the range 0.1 to 0.5. These sizes are judged suitable for effective removal by electrostatic precipitation; direct tests in this work confirmed this at least for very small (ca. 0.5 $dm^3 \times min^{-1}$) volumetric flow rates. Flow rates about 100-fold higher were processed using the plasma method. Electron beam currents between 10 and 100 μA produced conversions well above 90% with SO_2 concentrations in the range 100 to 5000 vpm, mixed in humidified air such that the molar ratio of oxygen to SO_2 equalled or exceeded 300. With flows up to 24 $dm^3 \times min^{-1}$, 20 mg x min^{-1} of sulfur dioxide was removed. 12 references, 8 figures, 3 tables.

34739 (LMF—114, pp 3-6) **Study of density effect and droplet deformation in the TSI aerodynamic particle sizer.** Chen, B.T.; Cheng, Y.S.; Yeh, H.C.; Crow, D.J. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

A study has been done to investigate the effects of droplet deformation and particle density on the performance of a TSI aerodynamic particle sizer (APS). Results indicated the existence of liquid deformation in the APS if the droplet size is greater than 3.5 μm. For solid aerosols of different densities (1.05-7.13 g/cm^3), there was no evidence of a density effect on the response of the APS. 6 references, 2 figures, 1 table.

34740 (LMF—114, pp 7-11) **Drag force and dynamic shape factor of nonspherical particles.** Cheng, Y.S. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

Dynamic shape factors of several isometric nonspherical particles were calculated from the drag coefficient data. This calculation showed that dynamic shape factors of these particles were constant for Reynold's numbers (Re) less than 0.05 and were a function of Re at higher Re. The dynamic shape factor increased slightly for Re up to approximately 50 to 200, and increased dramatically and reached a maximum for Re larger than 200. 3 references, 4 figures, 1 table.

34741 (LMF—114, pp 12-16) **Dynamic shape factors of doublets and triplets using a modified Millikan apparatus.** Cheng, Y.S.; Allen, M.D.; Gallegos, D.P. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

Dynamic shape factors (k's) of doublets and triplets were determined by single particle measurement in an improved Millikan apparatus. Doublets and triplets of latex particles of 2.07, 1.19, and 0.798 μm were used. Times of flight for charged particles in the viewing distance of Millikan cell were obtained. In an electric field, k_e (extrapolated to Knudsen number (Kn) = 0) of the doublet was 1.03, indicating an orientation with the long axis parallel to the flow direction. These particles were probably aligned by the electric field. Measurements of the same particle falling by gravity alone gave a k_e of 1.10, indicating a random orientation. Three particles of 2.07 μm size had a dynamic shape factor of 1.148 in the electric field, showing an orientation with the long axis perpendicular to the flow direction. 6 references, 4 figures, 1 table.

34742 (LMF—114, pp 17-19) **Improved condensation aerosol generator for dibenzocarbazole.** Cheng, Y.S.; Ayres, P.H. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

An improved vaporization-condensation aerosol generator was developed to generate submicron dibenzo[c,g]carbazole (DBC) aerosols for inhalation studies. A glass condensation chamber was added to the end of the tube-furnace in which the organic material was vaporized. Sheath-dilution air was added in the chamber to rapidly cool the vapor to room temperature and induce the condensation process in the chamber. The authors were able to generate the DBC aerosols in the concentration range of 1 to 10 mg/m^3 for 1 h with better control and stability than with vaporization-condensation aerosol generators used previously. 2 references, 4 figures.

34743 (LMF—114, pp 25-29) **System for laser generation of aerosols.** Hoover, M.D.; Allen, M.D.; Simpson, R.B.; Yeh, H.C. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

A pulsed Nd:YAG laser is being used to aerosolize material from the surface of metal targets of a variety of shapes. Targets in the form of rods up to 2-cm diameter can be attached to a lead screw mechanism that exposes a fresh surface for each laser pulse. Energies up to 20 J/pulse can be applied to the target, at pulse rates from a single shot to 300 Hz. Energy can be focused on an area with diameter less than 500 μm. Stainless steel and aluminum targets were used in a demonstration of system performance. The branched-chain ultrafine aggregate aerosols that were produced appear to result from vaporization/condensation of material from the surface of the target located under the center of the laser beam, and from ejection of molten droplets from the target surface under the periphery of the laser beam. 6 references, 3 figures.

34744 (LMF—114, pp 35-40) **Generation and monitoring of monodisperse ammonium fluorescein aerosols.** Chen, B.T.; Crow, D.J. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

A method based on real-time responses of an aerodynamic particle sizer has been developed to monitor the formation of monodisperse solid aerosol particles after a drying process. With this method, the time-consuming conventional way of ensuring the dryness, sphericity, and monodispersity of particles with electron microscopic studies is not required. The technique has been used successfully to monitor the generation of monodisperse ammonium fluorescein particles (3-17 μm) with a vibrating orifice aerosol generator under certain operating conditions. 3 references, 1 figure, 2 tables.

34745 (LMF—114, pp 41-44) **Evaluation of a 96-port nose-only exposure chamber.** Hoover, M.D.; Mewhinney, C.J. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

The ITRI 80-port small animal nose-only exposure chamber was modified to accommodate 96 animals. Chamber height was increased to provide an additional row of exposure ports on each side. Center-to-center port separation was increased to accommodate larger diameter exposure tubes. Exhaust was withdrawn directly from the ends of the individual extraction tubes, rather than from a common plenum. Port-to-port coefficient of variation was less than 7% in tests with /sup 99m/Tc-labeled NaCl particles (nominal AMAD 1.2 μm σ/sub g/ 1.8) at a total flow of 20 L/min. The coefficient of variation in initial lung burden per kg body weight among F344/N rats exposed to CeO_2 particles (nominal AMAD 1.1 μm, σ/sub g/ 1.7) at a total flow of 30 L/min was 22%. These results are in agreement with previous results for the 80-port chamber. 3 references, 1 figure, 1 table.

34746 (LMF—114, pp 52-54) **Photochemical degradation of benzo(a)pyrene and 1-nitropyrene on diesel exhaust particles.** Benson, J.M.; El-Mogazi, D.; Cheng, Y.S.; Yeh, H.C. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

Benzo(a)pyrene (BaP) and nitropyrene (NP) undergo photodecomposition when exposed to natural sunlight. To evaluate photodecomposition of these compounds when part of a complex organic mixture, ^{14}C-BaP and ^{14}C-NP were coated onto diesel exhaust particles and exposed to natural sunlight for 2 to 60 h. Using dichloromethane, recovery of ^{14}C from freshly coated diesel particles was 25%. Extracts of particles exposed to sunlight for 60 h contained > 90% ^{14}C-BaP and ^{14}C-NP, suggesting that either little

photolysis occurred or that photolysis products were not extracted by the procedure used. 1 reference, 2 tables.

34747 **(PB—86-121100/XAB) National air-pollutant emission estimates, 1940-1984. Final report.** (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Jan 1986. 62p. (EPA/450/4—85/014). NTIS, PC A04/MF A01.

The report presents estimates of trends in nationwide air pollutant emissions for the six major pollutants: sulfur oxides, particulates, carbon monoxide, volatile organic compounds, nitrogen oxides, and lead. Estimates are broken down according to major types of air-pollutant sources. A short analysis of emission trends is given, along with a discussion of methods used to develop the data.

34748 **(PB—86-145489/XAB) Impact of primary sulfate and nitrate emissions from selected major sources. Phase 2: sulfuric acid plant and pulp and paper mill. Report for January 1981-June 1985.** McCain, J.D.; Kistler, W.G.; Carnes, D.H. (Southern Research Inst., Birmingham, AL (USA)). Jan 1986. 163p. NTIS, PC A08/MF A01.

The report covers Phase two of a two phase study of the near source impacts of primary sulfate and nitrate emission sources. The phase two portion of the study was an investigation of the impact of the emissions from a sulfuric acid plant, and a pulp and paper mill. The study was designed to measure the increases in the ground-level ambient air sulfate and nitrate concentrations resulting from the plant's emission within ten kilometers of the plants. The field sampling involved concurrent sampling at the source and in the ambient upwind and downwind of the plants for particulate matter, sulfates, nitrates, sulfuric acid, nitric acid, SO_2, and NOx. The tests were conducted in Savannah, Georgia and were centered around a sulfuric acid plant operated by American Cyanamid; Inc., and a pulp and paper mill operated by the Union Camp Corporation. Both plants operated at full capacity throughout the tests. The factor analyses based on elemental analyses of the ambient air particulate samples, the plants emission and local soil samples indicated that wind-blown soil was the dominant source of ambient particulate matter. The target sources were responsible for only a small fraction of sulfate and nitrates. The major source appeared to be secondary aerosols, perhaps dominated by long-range transport.

34749 **(PB—86-145786/XAB) Identification and comparative risk assessment of airborne carcinogens from combustion sources.** Lewtas, J.; Nishioka, M.G.; Petersen, B.A. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). Jan 1986. 54p. (EPA/600/D—86/013). NTIS, PC A04/MF A01.

The identification and assessment of airborne carcinogens has been significantly advanced by the use of short-term genetic bioassays. Bioassay-directed fractionation coupled with new organic characterization methods has provided the tools needed to more efficiently identify potential carcinogens in complex combustion emissions and urban air samples. These studies have shown that a significant portion of the mutagenicity is found in fractions more polar than polynuclear aromatic hydrocarbons (PAHs). New mass-spectrometry techniques have been developed to identify and quantify the more polar mutagens in these samples. The comparative mutagenicity and carcinogenicity of a series of combustion emissions has been assessed using dose-response studies in bacteria, mammalian cells and rodents. This data base has been used to develop a comparative potency risk assessment methodology for a series of combustion emissions.

34750 **(PB—86-146511/XAB) Microcomputer programs for particulate control: section failure; baghouse; plume opacity prediction; and in-stack opacity calculator. Software.** Sparks, L.E. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). 1 Sep 1985. vp. (EPA/600/8—85/025). NTIS, PC A99/MF A01.

IBM-PC usable versions of several computer models useful in particulate control are provided. The models were originally written for the TRS-80 Model I-III series of microcomputers and have been translated to run on the IBM-PC. The documentation for the TRS-80 versions applies to the IBM-PC versions. The programs are written in FORTRAN and are provided in both source (FORTRAN) and executable form. Some small machine language routines are used to format the screen for data entry. These routines limit the programs to IBM-PC and close clones. The minimum hardware requirements are 256K IBM-PC or close clone, a monochrome monitor, and a disk drive. A printer is useful but not required. The following computer programs are provided in the four-disk package: (1) ESP section failure model, (2) GCA/EPA baghouse model, (3) Plume opacity prediction model, and (4) In-stack opacity calculator. All the models are documented in EPA report Microcomputer Programs for Particulate Control, EPA-600/8-85-025a (PB86-146529). The models provide useful tools for those involved in particulate control.

34751 **(PB—86-146529/XAB) Microcomputer programs for particulate control. Documentation. Final report, January-June 1985.** Owen, M.K.; Viner, A.S. (Research Triangle Inst., Durham, NC (USA)). Sep 1985. 318p. (EPA/600/8—85/025A). NTIS, PC A14/MF A01.

The report describes the development of a set of programs especially for air-pollution related problems. (The phenomenal growth of the microcomputer industry has made it possible for anyone in industry to have a relatively fast and easy-to-use computer. Unfortunately, the specialized software needs of the air-pollution community have not been met.) The report describes: microcomputer programs of electrostatic precipitator performance, an implementation of the GCA/EPA baghouse model; an in-stack opacity prediction program; and a plume opacity model. User benefits, hardware/software requirements, and general restrictions are given, as well as brief descriptions of the theoretical models. A sample problem, which gives detailed instructions on how to use the menus and obtain desired results, is included for each program.

34752 **(PB—86-148129/XAB) Evaluation of gypsum crystallization for limestone flue-gas desulfurization.** Chang, J.C.S.; Brna, T.G. (Acurex Corp., Research Triangle Park, NC (USA)). Jan 1986. 21p. NTIS, PC A02/MF A01.

The paper gives results of pilot-plant tests using a double draw-off crystallizer as the hold tank to improve the gypsum dewatering properties of a forced-oxidation limestone flue gas desulfurization process. A hydroclone was used as the size-classification device for solids separation and fines removal. Compared with a mixed tank crystallizer, the double draw-off crystallizer resulted in a 45% reduction in free moisture within the filter and a 58% increase in filtration rate.

34753 **(PB—86-148210/XAB) Application of the empirical kinetic modeling approach to urban areas. Volume 3. Philadelphia.** Whitten, G.Z.; Hogo, H.; Yonkow, N.M.; Johnson, R.G.; Meyers, T.C. (Systems Applications, Inc., San Rafael, CA (USA)). Oct 1985. 104p. NTIS, PC A06/MF A01.

The Empirical Kinetic Modeling Approach (EKMA) was evaluated using the results of model applications in the Philadelphia area, primarily by comparing results of the box model (OZIPM) that forms the basis of the EKMA with those of more-sophisticated models. The study was carried out at several levels, beginning with evaluation of OZIPM and ending with an evaluation of the control-strategy predictions resulting from use of the EKMA isopleth methodology. OZIPM results were compared with those of the Urban Airshed Model (UAM), which is listed as one of the EPA's preferred models, and the Systems Applications Trajectory models, as well as with those obtained with modified versions of the original OZIPM model. The basic OZIPM model is a simple moving air parcel, or box, model that uses a detailed chemical mechanism for surrogate propylene and butane hydrocarbons. The model treats time-dependent precursor-emission factors and expansion of the air parcel. Entrainment is treated by assuming that constant concentrations exist outside the parcel. The primary emphasis of this comparison study was identification of features in the basic OZIPM model that could explain differences between the results of the OZIPM model and those of other models.

34754 **(PB—86-148277/XAB) Metropolitan tracer experiment (METREX). Technical memo.** Draxler, R.R. (National Oceanic and Atmospheric Administration, Silver Spring, MD (USA). Air Resources Lab.). Oct 1985. 110p. (NOAA-TM-ERL-ARL—140). NTIS, PC A06/MF A01.

Several perfluorocarbon gas tracers were released at regular intervals for 1 year just outside of the metropolitan Washington, DC area. Continuous 8-h samples were collected at a central downtown site and two adjacent suburban locations. Monthly air samples were collected at 93 sites throughout the region at urban, suburban, and rural locations. Meteorological measurements were made on 5 towers instrumented for the experiment. The collected data can be used to quantify the errors from various dispersion-modeling techniques as well as study the influence of an urban area on the dispersion of pollutants.

34755 **(PB—86-148426/XAB) Evaluation of rural-air-quality simulation models. Addendum B: graphical display of model performance using the Clifty Creek data base.** Cox, W.M.; Moss, G.K.; Tikvart, J.A.; Baldridge, E. (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Aug 1985. 60p. (EPA/450/4—83/003B). NTIS, PC A04/MF A01.

The addendum uses a variety of graphical formats to display and compare the performance of four rural models using the Clifty Creek data base. The four models included MPTER (EPA), PPSP (Martin Marietta Corp.), MPSDM (ERT), and TEM-8A (Texas Air Control Board). Graphic displays were developed and used for both operational evaluation and diagnostic evaluation purposes. Plots of bias of the average vs station downwind distance by stability and wind-speed class revealed clear patterns of accentuated underprediction and overprediction for stations closer to the source. PPSP showed a tendency for decreasing overprediction with increasing station distance for all meteorological subsets while the other three models showed varying patterns depending on the meteorological class. Diurnal plots of the bias of the average vs hour of the day revealed a pattern of underestimation during the nocturnal hours and overestimation during hours of strong solar radiation with MPSDM and MPTER showing the least overall bias throughout the day.

34756 **(PB—86-148467/XAB) Factors influencing the composition and quantity of passenger car refueling emissions. Part 1.** Lemmons, T.J.; Gabele, P.A. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). Jan 1986. 34p. (EPA/600/D—86/011). NTIS, PC A03/MF A01.

The paper describes the results of a study to examine the effects of various experimental variables on the quantity and composition of emissions associated with motor vehicle refueling. Problems related to accurate laboratory simulation of vehicle refueling are discussed. Preliminary results include emission rates for total hydrocarbons, benzene, toluene and 81 other hydrocarbon compounds for a single test vehicle.

34757 **(PB—86-150158/XAB) Measuring the electric field in the atmosphere in connection with investigations on the dispersion of air pollution.** van Wakeren, J.H.A.; Elshout, A.J.; Janssen, L.H.J.M. (Keuring van Electrotechnische Materialen N.V., Arnhem (Netherlands)). 1984. 14p. NTIS, PC A03/MF A01.

A new instrument was developed to measure the strength of the electric field in the atmosphere. This E-field meter installed on a mobile platform, e.g. an aircraft or a van, makes it possible, to locate the position and establish the dimensions of a stack plume. The E-field meter is light, requires very little energy and is not very expensive. The important difference between this and other E-field measuring instruments is that it also functions in a humid atmosphere with fog or rain because it functions as an ammeter instead of a voltmeter.

34758 **(PB—86-150620/XAB) Dioxin emissions from industrial boilers burning hazardous materials.** Castaldini, C.; Olexsey, R.A. (Acurex Corp., Mountain View, CA (USA). Energy and Environmental Div.). Jan 1986. 38p. NTIS, PC A03/MF A01.

Laboratory analyses for polychlorinated dibenzo-p-dioxins (PCDD) and polychlorinated dibenzo-furans (PCDF) were performed on waste fuels and stack gas emission samples from five industrial boiler test sites cofiring liquid hazardous wastes. Analytical results indicate that, apart from creosote sludge, chlorinated wastes were void of PCDD and PCDF compounds at detection limits in the range of 0.045 to 4.17 ppb. Creosote sludge cofired with wood waste in a stoker boiler was found to contain 7.4 ppm of total dioxins, primarily hepta and octa homologs.

34759 **(PB—86-150828/XAB) Mass-spectrometric study of nitro-PAHS (polycyclic aromatic hydrocarbons). Final report.** Korfmacher, W.A. (National Center for Toxicological Research, Jefferson, AR (USA)). Aug 1984. 23p. (NCTR—6234). NTIS, PC A02/MF A01.

Nitro-polycyclic aromatic hydrocarbons (nitro-PAHs) have been detected in diesel exhaust, urban air particulate matter, commercial carbon black, and photocopier toners. Nitro-PAHs are a human health concern because some of them are known to be potent bacterial mutagens and to be carcinogenic in experimental animals. Analytical methods for nitro-PAHs have included high performance liquid chromatography, gas chromatography (GC) with various detectors, GC/mass spectrometry (MS) operated in the positive ion election impact (EI) mode and in the negative-ion chemical ionization (NICI) mode (6,16). In addition, analysis of nitro-PAHs by high resolution MS and MS/MS have been reported. An alternative mode of MS ionization is negative-ion atmospheric pressure ionization mass spectrometry (NIAPIMS). NIAPIMS responds selectively to compounds that have a high electron affinity. Because nitrocompounds have a high electron affinity, they are a class of chemicals well suited for NIAPIMS analysis. Mitchum and Korfmacher have reported on the NIAPIMS of several nitro-PAHs using a Finnigan 4000 GC/NIAPIMS system. Recently, analysis of nitro-PAHs by NIAPIMS/MS has been reported by Fulford and co-workers using a TAGA 6000 instrument. In the report, the initial results of the GC/NIAPIMS analyses of several PAHs are described. These results suggest that the NIAPIMS system provides an alternative method of analysis for nitro-PAHs and offers the advantage of greater selectivity than is found in the conventional (electron-impact ionization) GC/MS mode.

34760 **(PB—86-150885/XAB) CITPUFF: a gaussian puff model for estimating pollutant concentration in complex terrain. Forest Service research paper.** Ross, D.G.; Fox, D.G.; Dietrich, D.L.; Childs, J.E.; Marlatt, W.E. (Forest Service, Fort Collins, CO (USA). Rocky Mountain Forest and Range Experiment Station). Jul 1985. 30p. (FSRP-RM—261). NTIS, PC A03/MF A01.

CITPUFF, is a puff-type dispersion model that uses a wind field calculated from a complex-terrain wind model. It accommodates a variety of source types including point, area, and line sources; calculates plume rise where applicable; and outputs a graphic display of puff trajectories and concentrations. The model is compared against models currently used for assessing air quality impacts in complex topography.

34761 **(PB—86-151677/XAB) Control of air emissions from hazardous-waste combustion sources: field evaluations of pilot-scale air-pollution-control devices.** Westbrook, C.W.; Tatsch, C.E.; Cottone, L. (Research Triangle Inst., Durham, NC (USA)). Jan 1986. 170p. NTIS, PC A08/MF A01.

Pilot-scale air-pollution control devices supplied by Hydro-Sonic Systems, ETS, Inc., and Vulcan Engineering Company were installed at the ENSCO, Inc. Incinerator in El Dorado, Arkansas, in the spring of 1984. Each of these units treated an uncontrolled slipstream of the incinerator exhaust gas. Simultaneous measurement of the total particulate and HCl in the gas streams were made at the inlet to and exit from the units using an EPA Method 5 sampling train. Particle sizing at both locations using Andersen impac-

tors was also done. The units supplied by Hydro-Sonics Systems and ETS, Inc. exhibited a high degree of HCl and particulate matter control. The Hydro-Sonic Tandem Nozzle SuperSub Model 100 gave the best overall performance for HCl and particulate control and ability to accommodate the variable composition of the exhaust gas.

34762 **(PB—86-154598/XAB) Rationale and plan for Center for Building Technology Research to improve indoor air quality.** McNall, P.E. (National Bureau of Standards, Washington, DC (USA). Center for Building Technology). Jan 1986. 89p. (NBSIR—86/3305). NTIS, PC A05/MF A01.

This report outlines a suggested five-year research plan for the Center for Building Technology (CBT) in support of resolving the emerging indoor-air-quality problem. The problem is defined, and the past research is summarized. The important Federal responsibilities are identified. NBS contributions and capabilities are noted. Future research needs are covered, and these form the basis for the CBT research plan, in cooperation with other Federal agencies, state and local governments, and the private sector.

34763 **(PB—86-154879/XAB) Weibull function as a dose-response model to describe ozone effects on crop yields.** Rawlings, J.O.; Cure, W.W. (North Carolina State Univ., Raleigh (USA)). 1985. 10p. NTIS, PC A02/MF A01.

Field experiments have demonstrated that ozone (O_3) pollution can reduce yields of important crop species. The assessment of the impact of O_3 is facilitated by the use of a family of dose-response models that covers the range of responses observed in field O_3 dose-response studies. The Weibull dose response model is a flexible, biologically realistic, model that has been found useful for this purpose. The purposes of the study are to discuss analyses of dose-response data using the Weibull model and its extensions, to identify some of the problems inherent in the use of a nonlinear dose-response model, and to show application of the model to two sets of experimental data.

34764 **(PB—86-155686/XAB) Environmental and occupational health regulations in the US lead industry. Open File report.** Anderson, C.W.; Behum, P.T.; Miller, F.W. (Bureau of Mines, Washington, DC (USA)). 1986. 77p. (BM-OFR—3-86). NTIS, PC A05/MF A01.

This report presents a study of regulations pursuant to four major environmental and occupational health laws and the compliance problems of primary and secondary lead smelters and lead-acid battery manufacturers. Technical feasibility and difficulties in implementing and administering the following standards are addressed: (1) the Occupational Safety and Health Administration standards for occupational exposure to lead, (2) the Environmental Protection Agency (EPA) national ambient air quality standard for lead, (3) the EPA hazardous waste management regulations pertaining to recycling of lead, and (4) the EPA effluent limitations under the Clean Water Act and amendments. Although alternative technologies for lead production are emerging and engineering controls are available for retrofitting existing facilities, the economic viability and universal adaptability of these measures are uncertain. Additional pilot- and demonstration-plant tests may be required for new lead-smelting and- refining processes. Regulatory approaches in dealing with compliance problems on a plant-by-plant basis would be beneficial. Such an approach should consider the technical and economic feasibility of engineering controls on existing processes and take into account the level of development of new processes.

34765 **(PB—86-156346/XAB) Miscellaneous metal parts coating summary report for technical support in development of a revised ozone State Implementation Plan for Memphis, Tennessee. Summary report.** (Pacific Environmental Services, Inc., Durham, NC (USA)). Jun 1985. 31p. NTIS, PC A03/MF A01.

The document presents information on emissions of volatile organic compounds (VOC) from a miscellaneous metal parts coating facility in Shelby County, Tennessee. The facility is reported to emit less than 25 tons per year of VOC. The results of the analysis are used to identify reasonably available control technology (RACT) for VOC emissions from miscellaneous metal parts coaters in Shelby County emitting or showing the potential to emit 25 tons per year or less of VOC. Emission sources, emission controls and costs, and operation of the miscellaneous metal-parts coating facility are described. The control measures described in the document represent the presumptive norm or reasonably available control technology (RACT) that can be applied to existing miscellaneous metal parts coating facilities. Reasonably available control technology is defined as the lowest emission limit that a particular source is capable of achieving by application of a control technology that is reasonably available considering technological and economic feasibility. It may require technology that has been applied to similar, but not necessarily identical, source categories. It is not intended that extensive research and development be conducted before a given control technology can be applied to a source. However, short-term evaluation programs are considered an appropriate technology forcing aspect of RACT. The measures considered include: (1) use of add-on control equipment, (2) use of reformulated coatings, and (3) improved application methods.

34766 **(PB—86-156353/XAB) Can-coating summary report for technical support in development of a revised ozone State Implementation Plan for Memphis, Tennessee.** (Pacific Environmental Services, Inc., Durham, NC (USA)). Jun 1985. 26p. NTIS, PC A03/MF A01.

The document presents information on emissions of volatile organic compounds (VOC) from a can-coating plant in Shelby County, Tennessee. This can coating facility is reported to emit less than 25 tons per year of VOC. Emission sources, emission controls and costs, and operation of the can manufacturing facility are described. The control measures described in the document represent the presumptive norm or RACT that can be applied to existing can-coating facilities. RACT is defined as the lowest emission limit that a particular source is capable of achieving by application of control technology that is reasonably available considering technological and economic feasibility. The measures considered are: (1) use of high solids or waterborne sealants and (2) control equipment, such as carbon adsorbers or incinerators.

34767 **(PB—86-156544/XAB) Estimation of individual ozone exposures using microenvironment measurements.** Contant, C.F.; Gehan, B.M.; Stock, T.H.; Holguin, A.H.; Buffler, P.A. (Texas Univ., Houston (USA). School of Public Health). Jan 1986. 18p. NTIS, PC A02/MF A01.

Estimates of an individual's ozone exposure were generated for a panel of 51 asthmatic study subjects using ambient ozone concentrations, the relationships observed between the ambient concentrations and the concentrations found in each of two broad classes of environments and knowledge of the individual's movement through these locations. These estimates are compared to actual ozone concentrations observed during personal monitoring of 30 of the individuals. Earlier comparisons disclosed that the estimated hourly means were in much better agreement with the observed hourly means than were the ambient hourly values. The hourly maxima observed in the personal monitoring for each of three environments are compared to the exposure estimates. The ability of the exposure model to estimate average hourly exposures for individuals has been previously tested. In the present work, the ability of the exposure model to estimate peak exposures within an hour is evaluated, using measurements of ozone concentration obtained at 5-minute intervals during the personal monitoring program as a standard. One-hour exposure estimates based on fixed-site measurements are evaluated as well. Sources of error within the data set are identified but appear to not seriously affect the results. The exposure model produces one-hour estimates which are 7-12 ppb below the observed personal exposures.

34768 **(PB—86-156940/XAB) Health effects of ambient ozone exposure in vigorously exercising adults.** Selwyn, B.J.; Stock, T.H.; Jenkins, D.E.; Kotchmar, D.J.; Chapman, R.S. (Texas Univ., Houston (USA). School of Public Health). Jan 1986. 21p. NTIS, PC A02/MF A01.

The purpose of the analysis was to examine the association of changes in ambient ozone concentrations with changes in the pulmonary function (PFT) of healthy adults after exercising vigorously outdoors. During May-October, 1981, 24 community resi-

dents (men and women) ran three miles twice a week some time between 4:30 and 6:30 PM at a high school track near Houston, Texas. An air-monitoring trailer stood beside the track and monitored environmental variables continuously. The continuously measured environmental variables in this analysis (ozone, temperature, and relative humidity) were averaged over 15 minute intervals. Standard forced expiratory maneuvers were performed before and after each run. Exercise exertion was standardized.

34769 **(PB—86-157583/XAB) Wood-furniture coating: summary report for technical support in development of a revised ozone State Implementation Plan for Memphis, Tennessee.** (Pacific Environmental Services, Inc., Durham, NC (USA)). Jun 1985. 57p. NTIS, PC A04/MF A01.

The document presents information on emissions of volatile organic compounds (VOC) from wood-furniture-coating facilities in Shelby County, Tennessee. Information is presented on the industry, emissions from wood-furniture-coating facilities, emission control techniques, and the costs of reducing emissions. Sources of information include plant visits to furniture coating facilities in Shelby County, a review of Shelby County permit applications, the 1985 VOC emissions inventory for Shelby County, discussions with furniture coating facilities and spray equipment vendors, a review of technical literature, and studies conducted in other states. The control measures described in the document represent the presumptive norm or reasonably available control technology (RACT) that can be applied to existing furniture coating plants. It may require technology that has been applied to similar, but not necessarily identical, source categories. It is not intended that extensive research and development be conducted before a given control technology can be applied to the source. However, short-term evaluation programs are considered an appropriate technology-forcing aspect of RACT.

34770 **(PB—86-157781/XAB) Spectral fingerprinting of polycyclic aromatic hydrocarbons in high-volume ambient air samples by constant energy synchronous luminescence spectroscopy.** Kerkhoff, M.J.; Lee, T.M.; Allen, E.R.; Lundgren, D.A.; Winefordner, J.D. (Florida Univ., Gainesville (USA)). 1985. 8p. NTIS, PC A02/MF A01.

A high-volume sampler fitted with a glass-fiber filter and backed by polyurethane foam (PUF) was employed to collect airborne particulate and gas-phase polycylic aromatic hydrocarbons (PAHs) in ambient air. Samples were collected from four sources representing a range of environmental conditions: gasoline-engine exhaust, diesel-engine exhaust, air near a heavily traveled interstate site, and air from a moderately polluted urban site. Spectral fingerprints of the unseparated particulate and gas-phase samples were obtained by constant-energy synchronous luminescence spectrocopy (CESLS). Five major PAHs in the gas-phase extracts were characterized and estimated. The compatibility of a high-volume sampling method using polyurethane foam coupled with CESLS detection is explored for use as a screening technique for PAHs in ambient air.

34771 **(PB—86-158409/XAB) Use of monitored air concentrations to infer dry deposition (1985). Technical memo.** Hicks, B.B.; Baldocchi, D.D.; Hosker, R.P.; Hutchison, B.A.; Matt, D.R. (National Oceanic and Atmospheric Administration, Silver Spring, MD (USA). Air Resources Lab.). Nov 1985. 78p. (NOAA-TM-ERL-ARL—141). NTIS, PC A05/MF A01.

The need for dry-deposition data to parallel the wet-deposition information obtained in routine monitoring networks is well known, but so are the difficulties. Because there is no simple device capable of measuring the dry-deposition rates of small particles and trace gases directly, most current activity is focused instead on the use of a concentration-monitoring procedure. In this method, measurements of the atmospheric concentration (C) of selected chemical species are coupled with evaluations of the appropriate deposition velocity (vd) so as to yield estimates of the dry-deposition rate from the product F = vd.C. Difficulties arise concerning the ability to measure C accurately, and especially regarding the present poor state of knowledge about vd for many species.

34772 **(PB—86-158698/XAB) Effect of acid mist and air pollutants on yellow-poplar seedling height and leaf growth. Forest Service research paper (Final).** Dochinger, L.S.; Jensen, K.F. (Forest Service, Broomall, PA (USA). Northeastern Forest Experiment Station). 1985. 10p. (NEFES—86-13). NTIS, PC A02/MF A01.

One-year-old yellow-poplar seedlings were treated with acid mist at pH 2.5, 3.5, 4.5, and 5.5 either alone or in combination with 0.1 ppm O_3, SO_2, and NO_2 or NO_2 plus SO_2. After 4 and 8 weeks of treatment, height, leaf area, and leaf and new shoot weight were determined and growth analysis variables calculated. Height, leaf area, and dry weight decreased with increasing acidity in seedlings treated with acid mist alone. Similar, but smaller reductions occurred in seedlings treated with SO_2 and acid mist, but no differences were found in seedlings fumigated with NO_2, NO_2 plus SO_2 or ozone and acid mist.

34773 **(PB—86-159209/XAB) Effects of air pollution and acid rain on fish, wildlife, and their habitats - lakes. Final report.** Potter, W.; Peterson, M.A. (Fish and Wildlife Service, Kearneysville, WV (USA). Eastern Energy and Land Use Team). Jun 1982. 127p. (FWS/OBS—80/40.4). NTIS, PC A07/MF A01.

Report number 4 of the series synthesizing results of scientific research related to the effects of air pollution and acid deposition on fish and wildlife resources deals with lake ecosystems. The effects of photochemical oxidants, particulates, and acidifying air pollutants on water quality and lake and wetland biota are summarized. The characteristics which indicate lake sensitivity to air pollutants, in particular acidifying pollutants, are discussed.

34774 **(PB—86-159233/XAB) Effects of air pollution and acid rain on fish, wildlife, and their habitats - grasslands. Final report.** Peterson, M.A. (Fish and Wildlife Service, Kearneysville, WV (USA). Eastern Energy and Land Use Team). Jun 1982. 73p. (FWS/OBS—80/40.7). NTIS, PC A04/MF A01.

Report 7 of the series synthesizing the results of scientific research related to the effects of air pollution and acid deposition on fish and wildlife resources deals with grasslands. General aspects of grassland ecosystems relevant to a discussion of air pollution effects are presented along with a brief introduction to various other types of ecosystem stresses.

34775 **(PB—86-160280/XAB) Feasibility of using radioactive sulfur in long-range transport experiments. Final report, October 1983-October 1984.** Michael, P. (Brookhaven National Lab., Upton, NY (USA)). Jan 1986. 23p. NTIS, PC A02/MF A01.

The radioactive isotope sulfur-35 is an ideal tracer of sulfur emissions from anthropogenic sources because it would undergo the same chemical transformations in the atmosphere as the more common isotopes of sulfur, and further it has a very low natural-background concentration. A conceptual experiment using a simple transport model shows that for continual releases over a year and requiring detection at 1000 km, a source strength of about 180 curies per week is necessary. Calculations using a wind rose Gaussian plume model indicated that the air concentrations near the release point would be below Federal minimum values set for protection of the public safety. Production of the isotope is within existing technology although material costs could run as high as one million dollars for a full years release. Sampling and detection methods would require state-of-the-art technology with an investment of about one half the material costs. The general conclusion is that such a tracer experiment is technically feasible. Public perception was not considered in the study and a major effort of public education would be necessary before such an experiment could be carried out. An analysis of the possibility of using the stable isotopes Sulfur-34 and Sulfur-36 would require the development of new very expensive and specialized technology. Thus the use of stable isotopes was not considered to be feasible at the present time.

34776 (PB—86-164050/XAB) Impact of ozone on winter wheat yield. Kress, L.W.; Miller, J.E.; Smith, H.J. (Argonne National Lab., IL (USA)). 1985. 20p. NTIS, PC A02/MF A01.

Wheat is one of the more-important agricultural crops in the USA, and the major production areas may be subjected to potentially damaging concentrations of ozone (O_3). Since no information was available regarding the O_3 sensitivity of winter-wheat cultivars grown in the Midwest, plants of three cultivars were field-grown in open-top chambers and exposed to O_3 daily throughout the spring growing season to determine impact on grain yield. Also included was a non-chambered ambient air plot. Tests were conducted over a two-year period and compared. The study was initiated to provide further biological response data suitable for evaluating ambient air-quality standards and for use in the NCLAN economic assessment of the consequences of O_3 exposure to crops. The specific objective was to establish the exposure-response relationships between yield of three important cultivars of soft red winter wheat grown in the Midwest and chronic exposures to a range of O_3 concentrations.

34777 (PB—86-165735/XAB) Emissions trading: the implications for attainment of environmental quality goals, SO_2 management, and Western coal policy. (Council on Environmental Quality, Washington, DC (USA)). 13 Aug 1985. 184p. NTIS, PC A09/MF A01.

Contents include: overview of the emissions-trading issue; capital turnover and the coalition of interests in environmental regulation; SO_2 emission trading: an analysis of institutions; geographical and jurisdictional issues in designing emission trading systems; acid rain: a survey of the issues; and further perspectives.

34778 (UCRL—15787) Report on my activities at Lawrence Livermore National Laboratory, April-July 1985. Covey, C. (Miami Univ., FL (USA)). 10 Jul 1985. Contract W-7405-ENG-48. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86009701.

The report discusses the author's activities at LLNL while working on general circulation model studies of "nuclear winter". The activities included developing modifications to the radiation code representing absorption of sunlight by smoke, and combining the GCM with GRANTOUR so that smoke could be advected and removed by GCM-computed meteorology. (ACR)

34779 (UCRL—15807) Model projections of the equilibrium climatic response to increased carbon dioxide. Schlesinger, M.E.; Mitchell, J.F.B. (Oregon State Univ., Corvallis (USA); Meteorological Office, Bracknell (UK)). 1986. Contract W-7405-ENG-48. 27p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86010555.

To investigate the extent to which a doubling of the CO_2 concentration would alter the earth's climate, a hierarchy of mathematical climate models was used to simulate the change in the equilibrium climate resulting from a doubling of the CO_2 concentration from 300 to 600 ppM. The results from simulations by energy balance models, radiative-convective models, and atmospheric general circulation models are critiqued in this report. (ACR)

34780 (UCRL—15808) Analysis of results from energy balance and radiative-convective models. Appendix A. Schlesinger, M.E. (Oregon State Univ., Corvallis (USA)). 1986. Contract W-7405-ENG-48. 40p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86010554.

Three different types of climate models have been used to simulate the change in the equilibrium climate resulting from an increase in the carbon dioxide (CO_2) concentration: energy balance models (EBMs), radiative-convective models (RCMs), and general circulation models (GCMs). This appendix presents a detailed analysis of the results from EBMs and RCMs. The discussion places emphasis on the quantitative understanding of climate feedback processes. For this reason, the discussion necessarily involves a highly mathematical approach. This approach is helpful for analyzing the differences in sensitivity among climate models.

34781 Oxidation of SO_2 in fog droplets by primary oxidants. Benner, W.H.; McKinney, P.M.; Novakov, T. (Lawrence Berkeley Lab., CA). *Atmospheric Environment;* **20**: No. 1, 1377-1383(1986). Contract AC03-76SF00098.

Experiments described in this paper demonstrate that incomplete combustion is a source of gas-phase oxidants. These species, when dissolved in water, are manifested predominantly as H_2O_2. Experiments involving a fog chamber show that these primary oxidants oxidize SO_2 to sulfuric acid or sulfate in fog droplets. Drying such fog droplets results in suspended particles. For a constant SO_2 concentration and amount of fuel combusted, the amount of SO_2 oxidized and the amount of oxidant produced depend critically on the combustion conditions, being highest for incomplete combustion and negligible for stoichiometric flames.

34782 Formation of sulfate in non-precipitation clouds. Nair, S.K.; Peters, L.K.; Alkezweeny, A.J. (Univ. of Kentucky, Lexington, KY). *Proceedings, Annual Meeting, Air Pollution Control Association;* **1**: vp(1985). (CONF-850612—).

From Air Pollution Control Association annual meeting and exhibition; Detroit, MI, USA (16 Jun 1985).

In this paper the chemistry involved in cloud processes is modeled. Complementary field experiments were conducted during the Summers of 1983 and 1984 in and around Lexington, KY. The field experiments used a combination of aircraft and ground-based sampling. During the flights SO_2, NO_3,NO/sub x/, O_3, and particulate concentrations were measured. A.J. Alkezweeny et al. reported the first-order constant for conversion of SO_2 to SO/sup =/$_4$ from the experimental results reported in that study.

34783 Development of fugitive dust emission factors using a low-speed wind tunnel. Yocom, J.E.; Hoffnagle, G.F.; Brookman, E.T.; Bowne, N.E.; Miller, D.J.; Wilkinson, R.F. (TRC Environmental Consultants, Inc., East Hartford, CT). *Proceedings, Annual Meeting, Air Pollution Control Association;* **2**: vp(1985). (CONF-850612—).

From Air Pollution Control Association annual meeting and exhibition; Detroit, MI, USA (16 Jun 1985).

This paper describes a study to develop dust emission factors for the handling of wet-formed prilled sulfur using a low-speed wind tunnel. The wind tunnel was selected as being the most cost-effective method of developing relationships between rates, wind speed, and moisture content. Emission data were developed over a range of material moisture contents and horizontal wind speeds and were compared with emission factors developed from upwind-downwind tests.

34784 Chemical differences between event and weekly precipitation samples in northeastern Illinois. Sisterson, D.L.; Wurfel, B.E.; Lesht, B.M. (Argonne National Lab., IL). *Atmospheric Environment;* **19**: No. 9, 1453-1469(1985).

The authors examine the chemical differences between event and weekly samples of precipitation collected in northeastern Illinois from April 1980 to March 1982. Analyses were conducted for H^+, Ca^{2+}, Mg^{2+}, NH_4^+, SO_4^{2-} and NO_3^- concentrations as well as for pH and conductivity. In addition, the 1980-1981 samples, were titrated to determine the total, strong and weak acid concentrations. Although seasonal and annual precipitation amounts were different for the two years, the general pattern of event and weekly sample ion concentrations were similar. Weekly samples had significantly less [NH_4^+] and higher laboratory pH in all seasons and more [SO_4^{2-}] in every season but summer. Weekly sampled had significantly more [Ca^{2+}] and [Mg^{2+}] during seasons with little precipitation. Event and weekly [NO_3^-] were never significantly different. The weekly samples had more total acidity in the spring but less in the summer. The observed differences may be attributed to chemical degradation of the weekly samples while waiting collection and during shipment between the field and the laboratory.

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REFER ALSO TO CITATION(S) 33829, 33849, 34034, 34037, 34100, 34482

34785 **(FNAL—86/37) Site environmental report for calendar year 1985.** Baker, S.I. (Fermi National Accelerator Lab., Batavia, IL (USA)). 1 May 1986. Contract AC02-76CH03000. 97p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86010487.

This report summarizes the environmental activities and their results at Fermi National Accelerator Laboratory (Fermilab) for Calendar Year (CY-) 1985. Fermilab performed environmental monitoring in CY-1985 on three types of accelerator-produced radiation: penetrating, airborne, and waterborne. The penetrating radiation of concern was muons. Neutrons and gamma-rays were also monitored. The airborne radionuclide was ^{11}C and the primary waterborne radionuclide was ^{3}H (tritium). The highest off-site penetrating radiation level was 1.5% of the relevant standard. The highest airborne radionuclide concentration was 0.1% of the standard and the highest waterborne concentration was less than 0.6% of the standard. Monitoring for chemical pollutants in drinking water systems on the site indicated good water quality in all the wells sampled. The only parameters which exceeded the standard in any sample were iron, total dissolved solids, and in one well, sulfate. Monitoring results are also reported for non-radioactive pollutants. Included as pollutants are pesticides used in weed, insect, rodent, and algae control. In addition, results are included from monitoring the performance of the sewage treatment plant (Village Oxidation Pond) on-site.

34786 (KAERI/RR—450/84, pp 47-63, 149-152, 196) **Analysis of transport and diffusion of radioactive materials in the accident of nuclear power plant.** Lee, Young Bok; Kim, Byung Woo; Han, Moon Hee. (Korea Advanced Energy Research Inst., Daeduk, Republic of Korea). Apr 1985. (In Korean). NTIS (US Sales Only), PC A23/MF A01. File Number DE86780463.

In Studies on the safety assessment for environmental radiation and radioactivity (I).

This study is focused on the study of diffusion in the complex terrain such as in Korea which has mountainous regions. To compensate the vertical diffusion coefficients in the Pasquil-Gifford curves, the Gaussian model was compared with the numerical diffusion model using a variational technique. Next, early and chronic exposure doses were calculated with the computed coefficient according to the WASH-1400 scenario. The compensation of vertical dispersion coefficient in two-dimensional x-z plane has been accomplished by comparing the Gaussian plume model with numerical diffusion model. The results show that the concentrations of radioactive effluents over complex terrain are more diluted than those expected over flat terrain. Acute and chronic exposure in the PWR design basis accident-class 8 were analyzed using the CRAC-2 subroutines by the above diffusion coefficient.

34787 (LMF—114, pp 55-60) **Continuous monitoring of alpha radiation in an underground environment.** Seiler, F.A.; Newton, G.J.; Guilmette, R.A. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

Disposal of radioactive wastes underground requires continuous monitoring for airborne radioactive materials. In addition to a natural background of inert and radioactive aerosols, there may be a sizable dust contribution from mining and vehicular traffic. In monitoring the accumulation of alpha emitters in a continuous air monitor with a solid state detector, these aerosols may lead to a deterioration of the observed alpha-energy spectra. The influence of a realistic background aerosol on the performance of an alpha monitoring system has been studied and the frequency of false alarms due to natural radioactivity calculated. The results indicate that monitoring with alpha spectrometric methods may encounter serious difficulties when background aerosols are present. 2 references, 4 figures.

34788 **FOODCHAIN: A Monte Carlo model to estimate individual exposure to airborne pollutants via the FOODCHAIN pathway.** Dixon, E.; Holton, G.A. (Environmental and Occupational Safety Div., Oak Ridge National Lab., Oak Ridge, TN). pp 4129-4135 of Computer applications in health physics. Kathren, R.L.; Higby, D.P.; McKinney, M.A. Richland, WA; Health Physics Society (1984). (CONF-840202—).

From 17. midyear topical meeting of the Health Physics Society; Pasco, WA, USA (5 Feb 1984).

Human exposure to airborne radionuclides or chemical pollutants can be estimated by the computer models TEREX and FOODCHAIN. A range of estimated individual exposures is produced which covers the entire distribution of site- and pollutant-specific atmospheric depositions, food contaminant concentrations, and crop productions. The distribution of estimated exposures produced by TEREX and FOODCHAIN has been found to contain a greater degree of realism than the worst-case approach typically employed, because the maximum exposure estimate may have a very low probability, while the exposures with the highest probability lie within the midsection of the exposure estimate distribution.

34789 **MESOI, an interactive atmospheric dispersion model for emergency response applications.** Ramsdell, J.V.; Athey, G.F.; Glantz, C.S. (Pacific Northwest Lab., Richland, WA). pp 6063-6069 of Computer applications in health physics. Kathren, R.L.; Higby, D.P.; McKinney, M.A. Richland, WA; Health Physics Society (1984). (CONF-840202—).

From 17. midyear topical meeting of the Health Physics Society; Pasco, WA, USA (5 Feb 1984).

MESOI is an interactive atmospheric dispersion model that has been developed for use by the U.S. Department of Energy, and the U.S. Nuclear Regulatory Commission in responding to emergencies at nuclear facilities. MESOI uses both straight-line Gaussian plume and Lagrangian trajectory Gaussian puff models to estimate time-integrated ground-level air and surface concentrations. Puff trajectories are determined from temporally and spatially varying horizontal wind fields that are defined in 3 dimensions. Other processes treated in MESOI include dry deposition, wet deposition and radioactive decay.

34790 **Three health physics calculator programs for the HP-41CV.** Rittman, P.D. (Rockwell Hanford Operations, Richland, WA). pp 7049-7053 of Computer applications in health physics. Kathren, R.L.; Higby, D.P.; McKinney, M.A. Richland, WA; Health Physics Society (1984). (CONF-840202—).

From 17. midyear topical meeting of the Health Physics Society; Pasco, WA, USA (5 Feb 1984).

The Hewlett-Packard HP-41CV, a handheld programmable calculator, has alphanumeric display prompting to facilitate data input, and continuous memory to simplify field use. Three user-oriented programs will be discussed. First, a program to compute time integrated air concentrations at various distances from an airborne release. Building wake effects, source depletion by ground deposition, and sector averaging can all be included in the final printout if requested by the user. Second, a plutonium program which allows one to enter quantities of the six nuclides of concern in plutonium handling as weight percents, masses, or activities. The calculator then prints percent, mass, and activity tables together with total heat generation rate. Options are then to age the source and/or compute neutron generation rates from a user specified compound. Third, a timekeeping program to improve the process of estimating and tracking personnel exposure during high dose rate tasks, by replacing the usual pencil, paper, and stopwatch method. This program requires a time module.

34791 **The Hanford Environmental Data System.** Cowley, P.J.; Sula, M.J. (Pacific Northwest Lab., Richland, WA 99352). pp 3073-3078 of Computer applications in health physics. Kathren, R.L.; Higby, D.P.; McKinney, M.A. Richland, WA; Health Physics Society (1984). (CONF-840202—).

From 17. midyear topical meeting of the Health Physics Society; Pasco, WA, USA (5 Feb 1984).

The Hanford Environmental Data System (HEDS) is a comprehensive online, interactive data base used by the Pacific Northwest Laboratory's Hanford Environmental Surveillance Program. The Environmental Surveillance Program provides for the monitoring and evaluation of environmental radiological parameters in the Hanford environs for the purpose of assessing environmental impacts of site operations. Through software developed to utilize the data base, the system generates pre-printed labels from an internally stored sample collection schedule and tracks the collection and analysis of samples - providing notification in the event a sample is not collected or analyzed according to schedule. The system screens all incoming data using sample-specific criteria and generates a report for any data not meeting all criteria. Comments may be stored with any environmental measurement result entry.

34792 **Application of computers in a radiological survey program.** Berven, B.A.; Blair, M.S.; Doane, R.W.; Little, C.A.; Perdue, P.T. (Health and Safety Research Div., Oak Ridge National Lab., Oak Ridge, TN 37831). pp 7127-7132 of Computer applications in health physics. Kathren, R.L.; Higby, D.P.; McKinney, M.A. Richland, WA; Health Physics Society (1984). (CONF-840202—).

From 17. midyear topical meeting of the Health Physics Society; Pasco, WA, USA (5 Feb 1984).

Computers have become increasingly important in data analysis and data management as well as assisting in report preparation in the Oak Ridge National Laboratory (ORNL) Radiological Survey Activities (RASA) Program. The primary function of the RASA program is to collect, analyze, report, and manage data collected to characterize the radiological condition of potentially contaminated sites identified in the Department of Energy's (DOE) remedial action programs. Three different computer systems are routinely utilized in ORNL/RASA operations. Two of these systems are employed in specific functions. A Nuclear Data (ND) 682 is used to perform isotopic analysis of gamma spectroscopic data generated by high-purity germanium detectors for air, water and soil samples. The ND682 employs a 16,000-channel analyzer that is routinely used with four germanium spectrometers. Word processing and data management are accomplished using the INtext system implemented on a DEC PDP-11 computer. A group of personal computers are used to perform a diverse number of functions. These computer systems are Commodore Business Machines (CBM) Model 8032 with a dual floppy disk storage medium and line printers (with optional X-Y plotters). The CBM's are utilized for: (1) data analysis -- raw data from radiation detection instrumentation are stored and manipulated with customized computer programs; (2) data reduction -- raw data are converted into report-ready tables using customized programs; (3) data management -- radionuclide data on each air, water and soil sample are stored on diskettes along with location of archived samples; and (4) program management -- site surveys and report status are tracked by computer files as well as program budget information to provide contemporary information of program status.

34793 **An advanced computer-controlled automatic alpha-beta air sample counter.** Howell, W.P.; Bruinekool, D.J.; Stapleton, E.E. (Westinghouse Hanford Co., Richland, WA 99352). pp 7179-7181 of Computer applications in health physics. Kathren, R.L.; Higby, D.P.; McKinney, M.A. Richland, WA; Health Physics Society (1984). (CONF-840202—).

From 17. midyear topical meeting of the Health Physics Society; Pasco, WA, USA (5 Feb 1984).

An improved computer-controlled automatic alpha-beta air sample counter was developed, based upon an earlier automatic air sample counter design. The system consists of an automatic sample changer, an electronic counting system utilizing a large silicon diode detector, a small desk-type microcomputer, a high-speed matrix printer and the necessary data interfaces. The system is operated by commands from the keyboard and programs stored on magnetic tape cassettes. The programs provide for background counting, Chi^2 test, radon subtraction and sample counting for sample periods of one day to one week. Output data are printed by the matrix printer on standard multifold paper. The data output includes gross beta, gross alpha and plutonium results. Data are automatically corrected for background, counter efficiency, and in the gross alpha and plutonium channels, for the presence of radon.

34794 **An automated radon progeny analysis, data transmittal and computer processing system.** Jackson, P.O.; Brown, D.P.; Young, J.A. (Pacific Northwest Lab., P.O. Box 999, Richland, WA 99352). pp 7185 of Computer applications in health physics. Kathren, R.L.; Higby, D.P.; McKinney, M.A. Richland, WA; Health Physics Society (1984). (CONF-840202—).

From 17. midyear topical meeting of the Health Physics Society; Pasco, WA, USA (5 Feb 1984).

A system is described which automatically samples and monitors environmental concentrations of radon and thoron progeny in the air. The detector system has been combined with a data logger and modem to transmit accumulated measurements daily from a remote measurement site to a laboratory computer. Measurements are repeated at thirty-minute intervals and the concentrations are stored on magnetic tape on an HP-85 computer which is part of the Alpha Nuclear-Model 750 radon-thoron progeny analyzer. The instrument must be serviced at weekly intervals to rewind the moving filter tape. Once per day the data logger communicates with the laboratory computer and arranges the transfer of accumulated measurements of ^{218}Po, ^{214}Pb, ^{214}Bi, ^{216}Po, ^{212}Pb and working levels along with counting statistic precision estimates for each measurement. The system has been used to monitor radon-progeny concentrations in two homes in Edgemont, South Dakota. In addition to the radon-thoron progeny monitoring, the data logger is used to measure 15-minute averages of parameters which can influence radon-progeny concentrations. Those parameters, such as air-exchange rates, temperature and barometric pressure, are recorded and transmitted to the laboratory computer during the same daily transfer interval used for the radon-thoron progeny data transfer. Data arrays will be subjected to statistical analysis to determine correlations between parameters.

5006 Regulations

REFER ALSO TO CITATION(S) 34158, 34253, 34254, 34777

34795 **(NUREG/CR—3882) Method to characterize local meteorology at nuclear facilities for application to emergency response needs.** Lindsey, C.G.; Glantz, C.S. (Pacific Northwest Labs., Richland, WA (USA)). Apr 1986. Contract AC06-76RL01830. 62p. (PNL—5155). NTIS, PC A04/MF A01 - GPO. File Number TI86010156.

Effluent dispersion is evaluated using computer codes that require various meteorological parameters such as wind and stability data. These data will be based on current conditions at the site in question, and on forecasts of the expected local meteorology for the time period to be simulated. To assist NRC personnel in preparing these forecasts, a weather-typing model was implemented to analyze the characteristic behavior of local meteorology as it responds to various synoptic-scale weather features (e.g., warm fronts, cold fronts, high pressure systems). Historical observations acquired by instrumented towers at several nuclear power plants were analyzed as a function of the prevailing synoptic weather feature, synoptic-scale pressure gradient, and time of year. This study focused on sites located in shoreline and complex terrain environments because of the occurrence of mesoscale circulations, which are the sea/lake-land breeze and valley wind systems. Such circulations produce diurnally changing wind and stability conditions that cannot be readily identified by synoptic-scale weather forecasts. The advantage in analyzing the climatological behavior of local meteorology as it responds to various synoptic weather systems is that certain weather systems will control the local meteorology and produce persistent conditions.

34796 **(PB—85-214237/XAB) Air-quality data - 1984 annual statistics including summaries with reference to standards. Annual report.** (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Sep 1985. 370p. (EPA/450/4—85/005). NTIS MF A01.

The report presents comprehensive summaries of data produced by the nation's ambient-air-quality monitoring activities for 1984. The data are summarized in two formats: frequency distributions (Part I) and status of data with reference to standards (Part

II). These summaries are based on data acquired through extensive monitoring activities conducted by Federal, State, and local pollution control agencies and submitted to the U.S. Environmental Protection Agency's National Aerometric Data Bank. Information is provided on the six pollutants for which National Ambient Air Quality Standards have been set: total suspended particulates, carbon monoxide, sulfur dioxide, nitrogen dioxide, lead, and ozone.

34797 **(PB—86-151784/XAB) Surface coating of plastic parts for business machines - background information for proposed standards. Draft report.** (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Dec 1985. 268p. (EPA/450/3—85/019A). NTIS, PC A12/MF A01.

Standards of Performance for the control of VOC emissions from affected facilities that perform exterior surface coating of plastic parts for business machines are being proposed under authority of Section III of the Clean Air Act. These standards would apply to each new, modified, and reconstructed spray booth in which plastic parts for business machines are surface coated and that commence construction on or after the date of proposal of the regulation. The document contains background information and environmental and economic impact assessments of the regulatory alternatives considered in developing the proposed standards.

34798 **(PB—86-156791/XAB) Magnetic-tape-manufacturing industry - background information for proposed standards. Draft report.** (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Dec 1985. 345p. (EPA/450/3—85/029A). NTIS, PC A15/MF A01.

Standards of Performance for the control of VOC emissions from magnetic-tape coating lines are being proposed under the authority of Section 111 of the Clean Air Act. These standards would apply to all new, modified, and reconstructed magnetic tape coating lines using at least 38 cubic meters of solvent per year in the production of magnetic tape. The document contains background information and environmental and economic impact assessments of the regulatory alternatives considered in developing the proposed standards.

34799 **(PB—86-163102/XAB) Acid rain control legislation: costs to Maryland electric utilities and implementation issues. Final report.** Kete, N.; Roig, R.A.; Brown, D.H. (Maryland Dept. of Natural Resources, Annapolis (USA). Power Plant Siting Program). Dec 1985. 212p. (PPES—86-1). NTIS, PC A10/MF A01.

The report is one of a series of studies PPSP is conducting to determine the source and extent, environmental impacts, and costs of controlling acid rain in Maryland. The report estimates the potential costs to Maryland's four major utilities, and hence their rate payers, of implementing one possible national acid-deposition control strategy. This was done by examining present and projected Maryland sulfur dioxide and nitrogen oxide emissions, reviewing and analyzing legislation introduced during the 97th and 98th Congresses, developing a hypothetical acid-deposition control strategy based on the legislative analysis, and having each of Maryland's four major utilities determine its costs of complying with the hypothetical scenario.

51 ENVIRONMENTAL SCIENCES, TERRESTRIAL

5101 Basic Studies

34800 (INIS-mf—10111, pp 31) **Problems of geochemical evaluation of results of radioanalyses.** Podracky, P. (Ceskoslovenska Akademie Ved, Prague. Ustav Geologie a Geotechniky). May 1985. (In Czech). NTIS (US Sales Only), PC A03/MF A01. File Number DE86701997. (CONF-8505256—Absts.).

From IAA conference on instrumental activation analysis; Klucenice, Czechoslovakia (12 May 1985).

34801 **Groundwater transport: handbook of mathematical models.** Javandel, I.; Doughty, C.; Tsang, C.F. Washington, DC; AGU (1984). vp.

From review in E05; 65: No. 48, (27 Nov 1984).

A selection of various mathematical approaches and methodologies for estimating the extent of groundwater contamination is presented. The strengths and possible pitfalls in application of each method are clearly discussed. The methods presented range from simple analytical and semianalytical solutions to complex numerical codes. Detailed discussions of the assumptions underlying application of the methods are given. Primary emphasis is on the use of simple formulas and comprehensive tables. The book is practically oriented and readily usable as a guide in the field. Listings and user's guides for simple computer programs are given, which enable the reader to extend the tables.

34802 **Vegetation patterns in the North Black River peatland, northern Minnesota.** Glaser, P.H. (Univ. of Minnesota, Minneapolis). *Canadian Journal of Botany;* **61**: 2085-2104(1983).

Raised bogs and water tracks in the 193-km^2 North Black River peatland in northern Minnesota were examined in relation to the vegetation, water chemistry, and surficial water movements as inferred from infrared aerial photographs, LANDSAT imagery, and orthophoto topographic maps. Two noda of bog vegetation were distinguished by the Braun-Blanquet system; both bog noda are associated with relatively dilute, acidic waters (pH range 3.9-4.1; Ca^{2+} concentration range 0.6-1.6 mg L^{-1}; specific conductivity, K/sub corr/ range 1.3-83 $\mu S\ cm^{-1}$). Rich-fen vegetation in contrast is more variable within this peatland and generally occurs in water tracks with a correspondingly wide range of pH (range 5.0-6.2), Ca^{2+} concentration (range 3.6-30.4 mg L^{-1}), and K/sub corr/ (range 31 to 182 $\mu S\ cm^{-1}$). Poor-fen vegetation was most distinguishable by the transitional nature of its vegetation and water chemistry with at least a few minerotrophic indicator species present in all cases and intermediate ranges in pH (3.7-5.2), Ca^{2+} concentration (0.6-5.5 mg L^{-1}), and K/sub corr/(16-72 $\mu S\ cm^{-1}$). Bog and fen patterns in this peatland are consistently related to topographic features along the upland crest of each peatland watershed, indicating that topography controls the path of minerotrophic runoff draining onto the peatland, and thus creating zones with either enriched minerotrophic flow (in which water tracks develop) or stagnation zones (where bogs develop) on the peatland downslope. 43 references, 9 figures, 4 tables.

5102 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 34823, 34846, 34854, 34891

34803 **(CONF-8605107—1) Soil leaching in northern forest ecosystems.** Johnson, D.W. (Oak Ridge National Lab., TN (USA)). 1986. Contract AC05-84OR21400. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010040.

From Symposium on productivity of northern forests following biomass harvesting; Burlington, NH, USA (1 May 1986).

Natural leaching is being increased by both acid deposition and harvesting in northern forest ecosystems. Acid deposition is increasing the rates of calcium (Ca), potassium (K), and magnesium (Mg) leaching, but deficiencies of these elements are, as yet, rare. If deficiencies of a particular nutrient arise, both chemical and biological processes will act to conserve that nutrient. Harvesting can cause a temporary increase in nitrate (NO_3^-) and, consequently, Ca, K, and Mg leaching, especially in nitrogen-rich northeastern forests. In most cases, however, this post-harvest increase causes less nutrient export than that removed in biomass. Nevertheless, excessive NO_3^- leaching should be avoided to protect water quality. Nitrate leaching can be influenced by forest management practices, such as the type of cut, amount of woody residue left, and rate of regeneration. Accelerated leaching by acid deposition cannot be controlled by forest management, but fertilization can be employed to offset cation nutrient losses if they become critical.

34804 (GAO/NSIAD—86-22-BR) **Hazardous waste. Status of cleanup at the former West Virginia Ordnance Works.** (General Accounting Office, Washington, DC (USA). National Security and International Affairs Div.). Dec 1985. 11p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877. File Number TI86901299.

Briefing report to the Chairman, Subcommittee on Environment, Energy, and Natural Resources, Committee on Government Operations, House of Representatives.

After discussing its responsibility for cleanup with the Environmental Protection Agency (EPA) for 2 years, the Army has accepted the lead role of investigation and cleanup at the ordnance works. The various phases of the decontamination program appear to be progressing smoothly. Officials of both the EPA and the West Virginia Department of Natural Resources have expressed their overall satisfaction with the Army's actions. Our observations are presented in more detail on pages 6 and 7 of the enclosed briefing document.

34805 (KAERI/RR—450/84, pp 27-28, 86-107, 190-191) **Standardization of environmental monitoring.** Lee, Kang Suk; Ahn, Jong Sung; Kim, Kug Chan; Kim, Jin Kyu. (Korea Advanced Energy Research Inst., Daeduk, Republic of Korea). Apr 1985. (In Korean). NTIS (US Sales Only), PC A23/MF A01. File Number DE86780463.

In Studies on the safety assessment for environmental radiation and radioactivity (I).

To make comparison and assessmemt of survey data, it is necessary to standardize the method of terrestrial and marine ecosystem survey and the analytical methods for nonradioactive pollutants. Sampling items, frequency, scope and related descriptions in ecosystem survey were rearranged systematically. Analytical methods for nonradioactive pollutants in the environment were also suggested. By standization, monitoring methods about terrestrial and marine ecosystem survey and analysis of nonradioactive pollutants became more systematic and consistency of survey data can be done easily and non-efficient and economic loss at the surveying time can be avoided.

34806 (PB—86-151685/XAB) **Biogeochemistry of three Appalachian forest sites in relation to stream acidification. Final report.** DeWalle, D.R.; Sharpe, W.E. (Pennsylvania State Univ., University Park (USA). Inst. for Research on Land and Water Resources). Sep 1985. 46p. (LW—8510). NTIS, PC A03/MF A01.

Wet fallout, bulk precipitation, throughfall and soil leachate chemistry were studied from November, 1983 to November, 1984 at three Appalachian deciduous forest sites to determine the cause of differences in stream acidification. At one site on Fork Mtn. in northcentral West Virginia, where the stream exhibits little transient acidification during stormflows, soil leachate was found to be significantly less acidic and higher in dissolved calcium and magnesium. In contrast, on Peavine Hill in southwest Pennsylvania and Sand Mtn. in central Pennsylvania, where streams exhibit transient stormflow acidification, acidic soil leachate with high concentrations of dissolved manganese and aluminum were found. Thus, differences in stream acidification among sites seem to be in part caused by varying chemistry of soil water yielded to streams or groundwater reserves during storm periods. Differences in soil leachate chemistry among sites were attributed to higher atmospheric deposition of H(+) at the acid stream sites and higher weathering rates at the Fork Mtn. site of the meager amounts of calcium and magnesium compounds found in sandstone and shale parent materials.

34807 (PB—86-156312/XAB) **Stabilization/solidification of hazardous waste.** Hill, R.D. (Environmental Protection Agency, Cincinnati, OH (USA). Hazardous Waste Engineering Research Lab.). Jan 1986. 24p. (EPA/600/D—86/028). NTIS, PC A02/MF A01.

In response to the growing interest in stabilization and solidification of hazardous wastes and contaminated soils and sediments, the Land Pollution Control Division of EPA's Hazardous Waste Engineering Research Laboratory has produced a technical handbook on the subject. The handbook provides details of the materials and equipment in common use, and outlines methodologies for applying these techniques to hazardous-waste problems. Among the subjects covered are waste and site characterization, laboratory testing and leaching protocols, bench and pilot scale testing, and full-scale operations. Four stabilization/solidification scenarios are presented to illustrate advantages, disadvantages and costs for different mixing techniques.

34808 (PB—86-156916/XAB) **Comparative toxicology of laboratory organisms for assessing hazardous-waste sites.** Miller, W.E.; Peterson, S.A.; Greene, J.C.; Callahan, C.A. (Environmental Protection Agency, Corvallis, OR (USA). Environmental Research Lab.). 1985. 9p. (EPA/600/J—85/257). NTIS, PC A02/MF A01.

Multi-media/multi-trophic level bioassays have been proposed to determine the extent and severity of environmental contamination at hazardous waste sites. Comparative toxicological profiles for algae, daphnia, earthworms, microbes, mixed sewage and plants; wheat Stephens, lettuce, butter crunch, radish, Cherry Belle, red clover, Kenland, and cucumber, Spartan Valor are presented for selected heavy metals, herbicides and insecticides. Specific chemical EC50 values are presented for each test organism. Differences in standard deviations were compared between each individual test organism, as well as for the chemical subgroup assayed. Algae and daphnia are the most sensitive test organisms to heavy metals and insecticides followed in order of decreasing sensitivity by Microtox, DO depletion rate, seed germination and earthworms. Differences in toxicity of 2,4-D chemical formulations and commercial sources of insecticides were observed with algae and daphnia tests.

34809 (PB—86-158144/XAB) **Evaluation of available cleanup technologies for uncontrolled waste sites. Final report.** (Office of Technology Assessment (U.S. Congress), Washington, DC). 15 Nov 1984. 173p. NTIS, PC A08/MF A01.

The report presents an evaluation of cleanup technologies for remedial action at uncontrolled waste sites. For presentation purposes cleanup technologies are divided into two classes: containment and treatment. Containment technologies function primarily to isolate contaminants already in place in order to prevent harmful exposure to the environment and human populations. Treatment techniques function by destroying the inherent hazardous properties of the contaminants, or by separating them from environmental media that are the present or potential sources of human and environmental exposure. For the latter function, separations additional treatment or disposal may be required for the hazardous residues that are removed. Cleanup activities are presently taking place at many sites.

34810 (UCID—20716) **Environmental Assessment for the LGF Spill Test Facility at Frenchman Flat, Nevada Test Site.** Patton, S.E.; Novo, M.G.; Shinn, J.H. (Lawrence Livermore National Lab., CA (USA)). Apr 1986. Contract W-7405-ENG-48. 122p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE86009164.

The LGF Spill Test Facility at Frenchman Flat, Nevada Test Site, is being constructed by the United States Department of Energy (DOE). In this Environmental Assessment, environmental consequences of spilling hazardous materials in the Frenchman Flat basin are evaluated and mitigations and recommendations are stated in order to protect natural resources and reduce land-use impacts. Guidelines and restrictions concerning spill-test procedures will be determined by the LGF Test Facility Operations Manager and DOE based on toxicity documentation for the test material, provided by the user, and mitigations imposed by the Environmental Assessment. In addition to Spill Test Facility operational procedures, certain assumptions have been made in preparation of this document: no materials will be considered for testing that have cumulative, long-term persistence in the environment; spill tests will consist of releases of 15 min or less; and sufficient time will be allowed between tests for recovery of natural resources. Geographic limits to downwind concentrations of spill materials were primarily determined from meteorological data, human occupational exposure standards to hazardous materials and previous spill tests. These limits were established using maximum spill scenarios and environ-

mental impacts are discussed as worst case scenarios; however, spill-test series will begin with smaller spills, gradually increasing in size after the impacts of the initial tests have been evaluated.

5103 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 33766, 33847, 33848, 33864, 34034, 34391, 34785, 34788, 34792, 34858, 34904

34811 **(ANS—372) ECOS: values of parameters to be used for domestic animals.** Thorne, M.C. (Associated Nuclear Services, London (UK)). Mar 1984. 97p. NTIS (US Sales Only), PC A05/MF A01. File Number DE86702172.

This report constitutes the database description for the domestic animals section of the biosphere code ECOS. Two categories of data are supplied, element-independent and element-dependent. The element-independent data comprise rates of food, water and soil consumption, inhalation rates and masses of animal tissues. The element-dependent data consist of f_1 (fractional gastrointestinal absorption), fsub(D) (fractional systematic deposition after inhalation) and NRF (weighted integrated retention function) values. All parameter values given are justified.

34812 **(DOE/ID/12082—85) 1985 Environmental Monitoring Program report for the Idaho National Engineering Laboratory site.** Hoff, D.L.; Chew, E.W.; Rope, S.K. (Department of Energy, Idaho Falls, ID (USA). Idaho Operations Office). May 1986. Contract AS07-80ID12082. 55p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86010683.

The results of the various monitoring programs for 1985 indicated that radioactivity from the Idaho National Engineering Laboratory (INEL) Site operations could not be distinguished from worldwide fallout and natural radioactivity in the region surrounding the Site. Although some radioactive materials were discharged during Site operations, concentrations and doses to the surrounding population were of no health consequence and were far less than State of Idaho and Federal health protection guidelines. This report describes the air, water, and foodstuff samples routinely collected at the INEL boundary locations and at locations distant from the INEL Site. It compares and evaluates the sample results, discussing implications, if any. Included for the first time this year are data from air and water samples routinely collected from onsite locations. The report also summarizes significant environmental activities at the INEL Site during 1985, nonradioactive and radioactive effluent monitoring at the Site, and the US Geological Survey (USGS) groundwater monitoring program.

34813 **(DOE/OR/20722—102) Colonie Interim Storage Site annual site environmental report, calendar year 1985.** (Bechtel National, Inc., Oak Ridge, TN (USA). Advanced Technology Div.). May 1986. Contract AC05-81OR20722. 58p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86010608.

During 1985, the environmental monitoring program continued at the Colonie Interim Storage Site (CISS), Colonie, New York. The CISS is presently used for the storage of low-level radioactively contaminated soils. Monitoring results show that the CISS is in compliance with DOE concentration guides and radiation standards. DOE Derived Concentration guides represent the concentrations of radionuclides in air or water that would limit the radiation dose to an individual to 100 mrem/year. The applicable limits have been revised since the 1984 monitoring report was published. The limits applied in 1984 were based on a radiation protection standard of 500 mrem/y; the limits applied for 1985 are based on a standard of 100 mrem/y.

34814 (KAERI/RR—450/84, pp 64-70, 150-174, 196-197) **Environmental impact assessment around TRIGA research reactor.** Lee, Jeong Ho; Lee, Hyun Duk; Lee, Young Bok; Cheong, Kyu Hoi; Ahn, Jong Sung; Kim, Kug Chan; You, Byung Sun; Kim, Byung Woo; Kim, Sang Bok; Han Moon Hee. (Korea Advanced Energy Research Inst., Daeduk, Republic of Korea). Apr 1985. (In Korean). NTIS (US Sales Only), PC A23/MF A01. File Number DE86780463.

In Studies on the safety assessment for environmental radiation and radioactivity (I).

Population distribution, atmospheric change, X/Q, and characteristics of terrestrial ecosystem around Seoul site were surveyed. Environmental radiation and radioactivities such as grossα, grossβ, Cs-137, Sr-90 and H-3 of various environmental samples were analyzed. The values of environmental radiation dose tended to increase gradually in the light of the recent five years' results of environmental radiation monitoring around the nuclear power plants from 1980 to 1984, however, the changes were not significant. In addition, continuous assessment of environmental radiation monitoring on the roofs of main building and life science building at KAERI showed that the environmental radiation dose tended to increase a little during the night time. Judging from the above results, it is concluded that environmental contamination level by radioactive materials could be ignored in the case of radioisotope production or experiment using radioisotopes except the release of gaseous radioactive materials such as Ar-41 of short half life by the operation of nuclear reactor.

34815 (KAERI/RR—450/84, pp 29-46, 108-148, 192-195) **Monitoring and analytical assessment of environmental radioactivities during the operation of nuclear power plants.** Lee, Jeong Ho; Lee, Hyun Duk; Lee, Kang Suk; Ahn, Jong Sung; Cheong, Hae Won; Kim, Sam Rang; You, Byung Sun; Choi, Yong Ho; Kim, Chin Kyu; Kim, Sang Bok. (Korea Advanced Energy Research Inst., Daeduk, Republic of Korea). Apr 1985. (In Korean). NTIS (US Sales Only), PC A23/MF A01. File Number DE86780463.

In Studies on the safety assessment for environmental radiation and radioactivity (I).

The dose rates of environmental radiation were obtained from each site within 30 Km radius of Kori and Wolsung nuclear power plant. The major radionuclides in environmental aspects, i.e., tritium, strontium-90 and cesium-137 were analyzed for the terrestrial and marine samples, and their grossα and grossβ radioactivities were also measured. To understand the effects of plant operations on the marine ecosystem, a series of studies on physicochemical characteristics of sea water, marine microorganism counting and zooplankton mortality due to the entrainment were carried out for Kori and Wolsung nuclear power plant. Gross radioactivities and the contents of Sr-90 and Cs-137 in terrestrial samples such as plants, crops, soil, ground water and surface water around Kori site were not increased in comparison with the results in previous year. Gross activities of marine environmental samples collected around Kori site were almost the same as those investigated before the operation of the nuclear power plant and, on the whole, decreased a little compared with those measured in 1983.

34816 **(KAERI/RR—450/84) Studies on the safety assessment for environmental radiation and radioactivity (I).** (Korea Advanced Energy Research Inst., Daeduk (Republic of Korea)). Apr 1985. 526p. (In Korean). NTIS (US Sales Only), PC A23/MF A01. File Number DE86780463.

Individual papers are processed for the data base.

34817 **(LA—10721-ENV) Environmental surveillance at Los Alamos during 1985.** (Los Alamos National Lab., NM (USA)). Apr 1986. Contract W-7405-ENG-36. 220p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE86007870.

This report describes the environmental surveillance program conducted by Los Alamos National Laboratory during 1985. Routine monitoring for radiation and radioactive or chemical substances is conducted on the Laboratory site as well as in the surrounding region. Monitoring results are used to determine compliance with appropriate standards and to permit early identification of possible undesirable trends. Results and interpretation of data for 1985 cover: external penetrating radiation; chemical and radiochemical quality of ambient air, surface and ground waters, municipal water supply, soils and sediments, and foodstuffs; quantities of airborne emissions and liquid effluents; and environmental compliance. Comparisons with appropriate standards, regulations, and background levels from natural or other non-Laboratory sources provide the basis for concluding that environmental effects attributable to Laboratory operations are insignificant and are not considered hazardous to the population of the area or Laboratory employees.

34818 (LMF—114, pp 329-334) **Summary report on statistical analyses of cancer incidence patterns in the Denver metropolitan area in relation to the Rocky Flats plant.** Cuddihy, R.G.; Crump, K.S.; Ng, T.H. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

Statistical analyses were performed to determine if relationships existed between levels of plutonium soil contamination near the Rocky Flats plant and cancer incidences in people living nearby. Results showed that previously reported relationships largely disappeared when the statistical tests were controlled for an urban factor represented by distance of residence from the State Capitol Building in downtown Denver. No significant relationships were identified between plutonium soil concentrations and cancers in organs specifically known to be caused by internally deposited plutonium. In total, these analyses do not support a relationship between the Rocky Flats plant and area cancer incidence patterns. 6 references, 3 figures, 1 table.

34819 (MLM—3349) **Environmental monitoring at Mound: 1985 report.** Carfagno, D.G.; Farmer, B.M. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 5 May 1986. Contract AC04-76DP00053. 48p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86008137.

The environment locally surrounding Mound was monitored primarily for tritium and plutonium-238. The results are reported for 1985. Environmental media analyzed included air, water, vegetation, foodstuffs, and sediment. The average concentrations of plutonium-238 and tritium were within the DOE interim Derived Concentration Guides for radioactive species. Data concerning the emission of nonradioactive species into the atmosphere are also presented. All of these emissions were less than 3% of the applicable emissions standard.

34820 (NUREG—0837-Vol.5-No.4) **NRC TLD Direct Radiation Monitoring Network. Progress report, October-December 1985. Volume 5, No. 4.** Jang, J.; Rabatin, K.; Cohen, L. (Nuclear Regulatory Commission, King of Prussia, PA (USA). Region I). May 1986. 318p. NTIS, PC A14/MF A01 - GPO. File Number TI86901411.

This report presents the results of the NRC Direct Radiation Monitoring Network for the fourth quarter of 1985. It provides the ambient radiation levels measured in the vicinity of 74 sites throughout the United States. In addition, it describes the equipment used, monitoring station selection criteria, characterization of the dosimeter response, calibration procedures, statistical methods, intercomparison, and quality assurance program.

34821 (RFP-ENV—83) **Annual environmental monitoring report, January-December 1983.** (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 15 Apr 1984. Contract AC04-76DP03533. 60p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86010406.

This report documents the environmental surveillance program at the Rocky Flats Plant, as conducted by the Environmental Analysis Section of the Environmental and Occupational Health Branch. Sample analyses are performed by the Health, Safety, and Environmental laboratories of the Health, Safety and Environment Department and by the General Laboratory of the Quality Engineering and Control Department. This report includes an evaluation of plant compliance with all appropriate guides, limits, and standards. Potential public radiation dose commitments were calculated from average radionuclide concentrations measured at the plant property boundaries and in surrounding communities. Comparisons with appropriate guides, limits, and standards and with background levels from natural or other non-plant sources, provide a basis for concluding that no adverse environmental effects were attributable to the operation of the Rocky Flats Plant during 1983.

34822 (UNI—3880) **UNC Nuclear Industries reactor and fuels production facilities 1985 effluent release report.** Rokkan, D.J. (UNC Nuclear Industries, Inc., Richland, WA (USA)). 3 Apr 1986. Contract AC06-76RL01857. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86010605.

Analyses of routine samples from radioactive liquid and airborne streams were performed using UNC's Radioanalytical Laboratory and the analytical services of US Testing Company. All significant effluent discharges from UNC facilities to the environment during CY 1985 are reported in this document.

34823 (WAPD-RC/E(HE)—2316) **1985 Effluent and environmental monitoring report for the Bettis Atomic Power Laboratory.** (Westinghouse Electric Corp., West Mifflin, PA (USA)). [1985]. Contract AC11-76PN00014. 50p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86010748.

The results of the radiological and non-radiological environmental monitoring programs for 1985 at the Bettis Laboratory are presented. The results obtained from the monitoring programs demonstrate that the existing procedures ensure that all environmental releases during 1985 were in accordance with applicable State and Federal regulations. Evaluation of the environmental data indicates that operation of the Laboratory continued to have no adverse effect on the quality of the environment. Furthermore, a conservative assessment of radiation exposure to the general public as a result of Laboratory operations demonstrated that the dose received by any member of the public was well below the most restrictive dose limits prescribed by the Environmental Protection Agency and the Department of Energy.

34824 (RHO-HS-SR—85-3-4Q-LIQ-P) **Radioactive liquid wastes discharged to ground in the 200 areas during 1985.** Aldrich, R.C. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Mar 1986. Contract AC06-77RL01030. 168p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE86010001.

This document summarizes radioactive liquids discharged to the ground in the 200 areas of the Hanford site and is provided pursuant to Department of Energy (DOE) Order 5484.1A, "Environmental Protection, Safety, and Health Protection Information Reporting Requirements." There are twenty-eight liquid discharge streams in the 200 areas excluding sanitary sewers. Twenty-five streams were normally or potentially contaminated with radioactive material in 1985. Two streams had no potential for radioactive contamination but were included as adjustments in this report to maintain an accurate record of the total volume of the discharges to each disposal site. One stream, the 242-S Evaporator cooling water discharge, was not used during 1985.

34825 **A computer-controlled system for rapid soil analysis of ^{226}Ra.** Doane, R.W.; Berven, B.A.; Blair, M.S. (Health and Safety Research Div., Oak Ridge National Lab., Oak Ridge, TN 37831). pp 7173-7178 of Computer applications in health physics. Kathren, R.L.; Higby, D.P.; McKinney, M.A. Richland, WA; Health Physics Society (1984). (CONF-840202—).

From 17. midyear topical meeting of the Health Physics Society; Pasco, WA, USA (5 Feb 1984).

A computer-controlled multichannel analysis system has been developed by the Radiological Survey Activities (RASA) Group at Oak Ridge National Laboratory (ORNL) for the Department of Energy (DOE) in support of the DOE's remedial action programs. The purpose of this system is to provide a rapid estimate of the ^{226}Ra concentration in soil samples using a 6 x 9 inch NaI(T1) crystal containing a 3.25 inch deep by 3.5 inch diameter well. This gamma detection system is controlled by a minicomputer with a dual floppy disk storage medium, line printer, and optional X-Y plotter. A two-chip interface was also designed at ORNL which handles all control signals generated from the computer keyboard. These computer-generated control signals are processed in machine language for rapid data transfer and BASIC language is used for data processing. The computer system is a Commodore Business Machines (CBM) Model 8032 personal computer with CBM peripherals. Control and data signals are utilized via the parallel user's port to the interface unit. The analog-to-digital converter (ADC) is controlled in machine language, bootstrapped to high memory, and is addressed through the BASIC program. The BASIC program is designed to be "user friendly" and provides the operator with several modes of operation such as background and analysis acquisition. Any number of energy regions-of-interest (ROI) may be analyzed with automatic background substraction.

Also employed in the BASIC program are the ^{226}Ra algorithms which utilize linear and polynomial regression equations for data conversion and look-up tables for radon equilibrating coefficients. The optional X-Y plotter may be used with two- or three-dimensional curve programs to enhance data analysis and presentation. A description of the system is presented and typical applications are discussed.

34826 **Contour plots of environmental data.** Chandler, R.L.; Hall, C.J. (Rockwell Hanford Operations, Richland, WA 99352). pp 7184 of Computer applications in health physics. Kathren, R.L.; Higby, D.P.; McKinney, M.A. Richland, WA; Health Physics Society (1984). (CONF-840202—).

From 17. midyear topical meeting of the Health Physics Society; Pasco, WA, USA (5 Feb 1984).

The UNIVAC 1100/44, supported by Boeing Computer Services Richland, provides the capability to plot three dimensional graphic plots and contour plots of environmental data. Currently a large amount of such data is collected. A FORTRAN program has been written which analyzes Sr-90 soil concentration data and produces three dimensional surface plots and/or contour plots utilizing the Flatbed Plotter and DISSPLA on the UNIVAC. Soil samples are taken at designated sample coordinate locations each year and the laboratory analysis results have been presented in tabular form in an annual report. Sr-90 concentrations are given for each sample coordinate. To make the data more useful for analysis, contour plots of Sr-90 soil concentrations were assembled for several successive years from annual report data. The result was a series of plots of isopleths which provided an estimate of Sr-90 soil concentrations throughout the site and not just at specific coordinates. In addition, any changes from year to year in soil concentrations were more apparent than they were when assembled in tabular form.

5105 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 33700, 34810, 34863

34827 **(BDX—613-3502) Annual site environmental report for calendar year 1985.** Ramirez, J.M. (Allied Corp., Kansas City, MO (USA). Bendix Kansas City Div.). Apr 1986. Contract AC04-76DP00613. 105p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE86010277.

Air, land, and water quality in the Kansas City Plant environment were monitored and results are reported for calendar year 1985. Routine environmental surveillance programs are designed to demonstrate compliance with various regulatory standards, including the National Pollutant Discharge Elimination System (NPDES) permit; state and local air quality regulations for stack emissions; federal pretreatment regulations for metal finishing industries; local sanitary sewer effluent regulations; and federal and state hazardous waste treatment storage and disposal regulations.

34828 **(PNL—5867) Southeast Alaska Acoustic Measurement Facility (SEAFAC) environmental data base review, evaluation, and upgrade.** Strand, J.A.; Skalski, J.R.; Faulkner, L.L.; Rodman, C.W.; Carlile, D.W.; Ecker, R.M.; Nicholls, A.K.; Ramsdell, J.V.; Scott, M.J. (Pacific Northwest Labs., Richland, WA (USA)). Apr 1986. Contract AC06-76RL01830. 109p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE86010489.

This report summarizes the principal issues of public concern, the adequacy of the environmental data base to answer the issues of concern, and the additional data collection required to support a National Environmental Policy Act (NEPA) review of the proposed Southeast Alaska Acoustic Measurement Facility (SEAFAC). The report is based on a review of the readily available environmental literature and a site visit. Representatives of local, state, and federal agencies were also interviewed for their personal insights and concerns not discovered during the literature review.

34829 **(UCRL—53674) Lawrence Livermore National Laboratory site seismic safety program: summary of findings.** Scheimer, J.F. (Lawrence Livermore National Lab., CA (USA)). Jul 1985. Contract W-7405-ENG-48. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010267.

This report summarizes the final assessments of geologic hazards at the Lawrence Livermore National Laboratory (LLNL). Detailed discussions of investigations are documented in a series of reports produced by LLNL's Site Seismic Safety Program and their consultants. The Program conducted a probabilistic assessment of hazards at the site as a result of liquefaction, landslide, and strong ground shaking, using existing models to explicitly treat uncertainties. The results indicate that the Greenville and Las Positas-Verona Fault systems present the greatest hazard to the LLNL site as a result of ground shaking, with a lesser contribution from the Calaveras Fault. Other, more distant fault systems do not materially contribute to the hazard. No evidence has been found that the LLNL site will undergo soil failures such as landslides or liquefaction. In addition, because of the locations and ages of the faults in the LLNL area, surface ground rupture during an earthquake is extremely unlikely.

52 ENVIRONMENTAL SCIENCES, AQUATIC

5201 Basic Studies

REFER ALSO TO CITATION(S) 34139, 34140, 34801

34830 **(INS-R—326) Wairakei tracer tests 1983.** McCabe, W.J.; Barry, B.J. (Department of Scientific and Industrial Research, Lower Hutt (New Zealand). Inst. of Nuclear Sciences). May 1984. 6p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86702168.

Tracer tests, with and without, hot water reinjection into WK213 showed returns of tracer iodine-131 in wells in both the Waiora Valley and the eastern end of the field. The effect of reinjection at a rate of 200 cu. m/h was to reduce the arrived time from 15 to 7 days. Increasing the rate of reinjection into WK62 from 30 cu. m/h to 200 cu. m/h seemed to increase the initial velocity of the tracer wave and the distance it moved. However, returns were recorded only in the adjacent wells WK61 and WK63 with a very small, and three days delayed, response in WK43.

34831 **(PB—86-152170/XAB) Behavior, disturbance responses, and feeding of bowhead whales Balaena mysticetus in the Beaufort Sea, 1980-1981.** Richardson, W.J.; Buchanan, R.A.; Clark, C.W.; Dorsey, E.M.; Fraker, M.A. (LGL Ecological Research Associates, Inc., Bryan, TX (USA)). Aug 1982. 461p. NTIS, PC A20/MF A01.

In August and September of 1981, the second year, of a five-year study of bowhead whales was completed in the Canadian Beauford Sea. The purpose of the project was to (1) document the normal behavior of bowheads; (2) describe the characteristics of waterborne noise resulting from offshore oil industry activities; (3) quantify the behavioral responses of bowheads to various offshore oil-industry activities, and (4) characterize bowhead feeding areas. Field activities were based in Tuktoyoktuk N.W.T. and were carried out from aircraft, boats, and shore camps.

34832 **(PB—86-153590/XAB) Bowhead whales in the Beaufort Sea: a summary of their seasonal distribution and activities, and potential disturbance by offshore oil and gas exploration and development.** Fraker, M.A.; Richardson, W.J. (LGL Ecological Research Associates, Inc., Bryan, TX (USA)). Oct 1980. 94p. NTIS, PC A05/MF A01.

A literature review was conducted to determine the status of information (as of 1980) on bowhead whale (Balaena mysticetus) behavior, potential sources of industrial disturbance during offshore oil and gas exploration and development, responses of bowheads to such disturbances and to identify data gaps. Approximately 102 references were reviewed in order to meet the goals of the literature summary. The spring and fall migration is described in terms of

timing and distribution in the Bering, Chukchi and Beaufort Seas. Individual sources of potential disturbance to bowheads due to offshore oil industry activities are described. A general discussion of the response of cetaceans to marine traffic, stationary marine industrial activities and effluents/discharges is presented.

34833 **(PB—86-161973/XAB) Bush River ichthyoplankton distributions near the proposed Perryman site.** Burton, W.H.; Jacobs, F.; Holland, A.F.; Cummins, R.A. (Martin Marietta Environmental Systems, Columbia, MD (USA)). Nov 1985. 79p. NTIS, PC A05/MF A01.

A survey of the ichthyoplankton inhabiting the waters adjacent to the proposed Perryman power plant site on the Bush River was conducted from 31 March to 13 September 1984. The results of the spring 1984 sampling showed that yellow perch (Perca flavescens) larvae were often abundant, reaching densities as high as 2,920/100 cu m. Comparison of the data with that from other ichthyoplankton surveys conducted in the Bush River suggests that the number of yellow perch larvae varied greatly among years. Abundance of white perch and clupeids varied less among years. Sampling of nearshore-shallow and deeper channel habitats revealed significant spatial differences in abundances of certain species.

5202 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 33519, 34764, 34773, 34774, 34785, 34805, 34806, 34808, 34955, 34957

34834 (DOE/ER—0238, pp 171-184) **Global biospheric response to increasing atmospheric carbon dioxide concentration.** Gates, D.M. (Univ. of Michigan, Ann Arbor). Dec 1985. NTIS, PC A14/MF A01. File Number DE86007397.

In Direct effects of increasing carbon dioxide on vegetation. Net ecosystem production is discussed and defined. The stimulation of primary productivity by CO_2 is discussed in a generic context; and biotic growth factor (the fractional change in the net primary production with a fractional change in the atmospheric CO_2 concentration) values for field-grown soybeans and tree leaves are experimentally defined. Evidence of growth enhancement from tree rings is presented. The accumulation of carbon by the biosphere and carbon budget inferences for the biosphere are discussed. 39 references, 2 tables.

34835 (FWS/OBS—80(40.21), pp 49-61) **Examination of the case for effects of acidic deposition on Ontario's fisheries.** Beggs, G.; MacLean, J.; Gunn, J.; Jones, M.; Minns, K. (Ministry of Natural Resources, Toronto, Ontario). Oct 1985. NTIS, PC A06/MF A01. File Number TI86900511. (CONF-8408184—Pt.1).

From 114. annual meeting of the American Fisheries Society; Ithaca, NY, USA (12 Aug 1984).

A coordinated program of studies is being conducted to examine the impacts of acidic precipitation on fisheries resources in Ontario. The focus for these studies has been the development of models that predict both the extent and rate of impacts and the uncertainties inherent in these predictions. Data on water chemistry and fish communities in lakes across the province are being collected and compiled. Field and laboratory studies are being conducted to determine the levels of pH and aluminum that early life history stages of fish are being exposed to and the effects of this exposure on their survival. Experiments are also being used to determine the cause of observed failures in recruitment of fish in sensitive lakes. With these studies as a background, the case for the effects of acidic deposition on fisheries resources in Ontario will be critically examined.

34836 (FWS/OBS—80(40.21), pp 26-27) **Factors contributing to the complexity of the acid precipitation surface water acidification problem.** Everett, A.G. (Everett and Associates, Rockville, MD). Oct 1985. NTIS, PC A06/MF A01. File Number TI86900511. (CONF-8408184—Pt.1).

From 114. annual meeting of the American Fisheries Society; Ithaca, NY, USA (12 Aug 1984).

Despite the abundant discussion (both technical and political) of the phenomenon of acidic deposition, the issues are still in the process of being defined scientifically as to the mechanisms of acidification of surface waters and effects on terrestrial systems. Anthropogenic atmospheric contributions to a naturally acidic atmospheric system having an antiquity of two billion years have been focused on almost to the exclusion of the natural system and its components and reactions. Similarly, acidic atmospheric contributions from anthropogenic sources have been the principle focus of terrestrial investigations, again largely ignoring the concurrent natural and other man-influenced reactions in terrestrial geochemical systems. In fact, a number of processes in atmospheric and terrestrial systems are dynamically coupled and vary both spatially and temporally, increasing the difficulty of studying them. For example, changes in land-use that result in increased forest soil humus, when concurrent with long-term climatic changes that increase the flushing of such acid soils by larger volumes of throughflow, would parallel what have been indicated as increased anthropogenic atmospheric deposition in acidification of surface waters. The scientific understanding of such complex interrelationships must be increased substantially before effective management of the hydrogeochemical systems can be achieved. At present, the scientific data and understanding for adequate management are emerging much more slowly than are proposed political solutions to the problem.

34837 (FWS/OBS—80(40.21), pp 28-29) **Detecting region-wide trends in surface water quality.** Hendry, G.R.; Hoogendyk, C.G.; Gmur, N.F. (Brookhaven National Lab., Upton, NY). Oct 1985. NTIS, PC A06/MF A01. File Number TI86900511. (CONF-8408184—Pt.1).

From 114. annual meeting of the American Fisheries Society; Ithaca, NY, USA (12 Aug 1984).

Studies of individual stations in the Northeast reveal long-term changes in chemical concentrations which may be related to acid deposition. Studies of populations of stations, such as the Adirondack Mountain lakes, indicate that acidification has occurred over the Adirondack Mountain lakes, indicate that acidification has occurred over the selected region, but since only end-members of a temporal change are known, the temporal pattern of change is unknown. By combining data from a large number of water quality sampling stations, it is possible to evaluate temporal patterns for geographically large regions. Because it is impractical to evaluate in great detail the quality of data from each of thousands of stations, patterns observed from analysis of such a large data set need to be confirmed by comparing them to patterns observed for more thoroughly examined stations. This multi-layered approach has the advantage of providing both the regional generality of a statistically based analysis, with a means of increasing verification of the patterns observed.

34838 **(PB—86-145539/XAB) Hazardous waste treatment technology.** (Environmental Protection Agency, Cincinnati, OH (USA). Hazardous Waste Engineering Research Lab.). Jan 1986. 78p. (EPA/600/D—86/006). NTIS, PC A05/MF A01.

Hazardous waste may be stored, treated, and disposed in a variety of ways. Treatment technology exists today for detoxification or destruction of wastes in an environmentally acceptable manner through physical, chemical and biological means. This volume covers several common alternative technologies for treatment of hazardous wastes as well as several emerging alternative technologies that show promise for future application. Thermal destruction of wastes through incineration, reaction with molten glass, etc., is not included as part of this effort. Alternative technologies are taken to be those that provide treatment techniques for waste other than landfilling, landfarming, or lagooning. These alternatives are further subdivided into existing and emerging technologies depending on whether or not they have been proven in full-scale tests and adopted for commercial use.

34839 **(PB—86-147162/XAB) Biological sulfate removal in an upflow packed-bed reactor.** Maree, J.P.; Strydom, W.F. (Council for Scientific and Industrial Research, Pretoria (South Africa). National Inst. for Water Research). 1984. 19p. NTIS, PC A04/MF A01.

A biological process for the removal of sulfate, using molasses as organic carbon source, is described. Sulfate is converted to

sulfur via sulfide, and molasses to bicarbonate. The process is accompanied by the precipitation of calcium carbonate and heavy-metal sulfides. Sulfate reduction follows zero-order kinetics with respect to both reactants and products. The reduction of 1 g sulfate consumes 1,2 ml molasses and requires 6 h for completion. The Darcian minimum upflow velocity for sulfate reduction in an anaerobic packed-bed reactor was found to be 1,3 m/h and the optimum temperature 31 C.

34840 **(PB—86-147188/XAB) Review of organic micropollutants: local experience detection, purification, and significance.** van Rossum, P.G. (Council for Scientific and Industrial Research, Pretoria (South Africa). National Inst. for Water Research). 1984. 25p. NTIS, PC A04/MF A01.

Organic micropollutants are defined and reasons given for the present-day interest in them. The relationship between analytical methodology, purification, and water quality is stressed. The development of analytical methods over the past 14 years is described in terms of attempts to solve a complex analytical problem. The importance of solubility, chemical reactivity and the aromatic/aliphatic characteristics of the pollutants in the purification process is illustrated. The effect of organic micropollutants on water quality is discussed in terms of criteria and the unidentified potential health hazardous organic compounds in drinking water.

34841 **(PB—86-150067/XAB) Technical support document for water quality-based toxics control.** Brandes, R.; Newton, B.; Owens, M.; Southerland, E. (Environmental Protection Agency, Washington, DC (USA). Office of Water Enforcement and Permits). Sep 1985. 114p. NTIS, PC A06/MF A01.

The reports provides guidance for each step in the water quality-based toxics control process from screening to compliance monitoring; Section 1 discusses the advantages and disadvantages of two approaches to toxics control: toxicity testing and chemical specific assessment; Section 2, Water Quality Criteria and Standards, contains a brief discussion of water-quality standards and the derivation of ambient criteria to attain and maintain standards; Section 3, Effluent Characterization, describes procedures that provide the data needed to make decisions regarding toxic impact. A two-tiered assessment approach is recommended; Section 4, Human Health Hazard Assessment, describes procedures for assessing potential human health hazards associated with effluents; Section 5, Exposure assessment, describes procedures for estimating exposure to toxicants and calculating effluent requirements based on ambient criteria and exposure; Section 6, Permit Requirements, describes methods to develop water quality-based NPDES permits.

34842 **(PB—86-153079/XAB) Accumulation of PCBs and Hg by fish and earthworms during field and laboratory exposures to Green Bay sediments. Administrative report.** Mac, M.J.; Edsall, C.C.; Hesselberg, R.J. (Fish and Wildlife Service, Ann Arbor, MI (USA). Great Lakes Fishery Lab.). Nov 1985. 29p. (USFWS-GLFL/AR—85-4). NTIS, PC A03/MF A01.

To determine whether the laboratory bioassay of Mac et al. (1984) was indeed predictive of the potential accumulation in an area with contaminated sediments, the authors conducted a field exposure of caged test organisms in lower Green Bay and a laboratory bioassay of sediments collected from the same area. The authors believe the results of this study provides an initial indication that the levels of bioaccumulation of contaminants from sediments in the laboratory are similar to what may be found in the natural environment, thus indicating potential predictive capability of the laboratory bioassay. The study further demonstrated the importance of sediment contact to the bioaccumulation process, even under conditions where significant bioaccumulation from water alone occurred.

34843 **(PB—86-154168/XAB) Guidance manual on overtopping control techniques for hazardous-waste impoundments. Final report, March 1983-September 1984.** Hodge, V.; DeSalvo, N.; Mahmud, S.; Margolis, J.; Evans, M. (JRB Associates, Inc., McLean, VA (USA)). Jan 1986. 108p. NTIS, PC A06/MF A01.

The overall objective of the project was to provide guidance for selecting cost-effective interim management methods to control overtopping of impoundments, pits, ponds, or lagoons at uncontrolled hazardous waste sites until final remedial actions could be initiated. Hazardous-waste impoundments are subject to overtopping through the collection of rainwater, run-on, or other uncontrolled inflow. Lagoon overflows are generally the result of insufficient capacity due to either insufficient freeboard (high level of lagoon contents) or structural problems that reduce the effective capacity. No matter what the cause, lagoon overflows can pose significant environmental and public health risks through the contamination of soils, groundwater, and surface water, as well as the potential to spread the contamination into areas not currently impacted by the lagoon. Thus, interim measures may be necessary to control lagoon overflows prior to identification and selection of a final remedial measure. A manual was prepared that addresses both immediate control measures for emergencies and longer-term measures lasting several months to several years. The technology and cost guidance presented is general in nature because of the variability of waste lagoons and impoundments and the unique conditions and considerations that exist at each site. Where possible, factors affecting application, technology selection, and costs are identified, as well as their likely impact on implementation and cost-effectiveness. Design issues are briefly presented as background to each option; however, the manual is not intended to replace the services of a qualified engineer in designing site-specific systems.

34844 **(PB—86-156304/XAB) Hazardous-waste research pertaining to metal finishing.** Dial, C.J. (Environmental Protection Agency, Cincinnati, OH (USA). Hazardous Waste Engineering Research Lab.). Jan 1986. 14p. (EPA/600/D—86/029). NTIS, PC A02/MF A01.

The paper, presented at the 7th American Electroplaters Society/Environmental Protection Agency Conference on Pollution Control for the Metal Finishing Industry, summarizes present and past metals-control research conducted by EPA and presents the approach that EPA is taking to establish standards for Best Demonstrated Available Technology for hazardous wastes.

34845 **(PB—86-156486/XAB) Design and construction of a mobile activated-carbon regenerator system. Final report, 6 August 1974-8 February 1979.** Hiltz, R.H. (MSA Research Corp., Evans City, PA (USA)). Jan 1986. 55p. (MSAR—81-107). NTIS, PC A04/MF A01.

Activated-carbon adsorption has become a standard procedure for the cleanup of contaminated water streams. To facilitate such cleanup at hazardous waste and spill sites, mobile carbon adsorption units have been constructed and are now in use. Their primary drawback is the logistics associated with the disposal of spent (contaminated) carbon and its replenishment with fresh, active carbon. The program was undertaken to assess the feasibility of designing and building a mobile carbon-regeneration unit - including an incinerator/scrubber to destroy the offgases - for field use in conjunction with mobile carbon-adsorption systems. A system was designed and built based on technology developed in the earlier fabrication of a laboratory-sized regenerator and on an in-depth evaluation of factors affecting system design and size. Housed in a standard van type of trailer, the system met all weight and size limitations for over-the-road transportation. The system includes a direct-fired, rotating-barrel kiln to thermally regenerate the carbon, an incinerator and scrubber to destroy the desorbed materials and treat the off-gases, and a separator to reclaim the reactivated-carbon granules. Test runs using spent carbon from an on-site treatment of a spill were quite successful. The carbon was returned to essentially 1005 activity with an 88% volume recovery. The unit has been delivered to the US EPA for their use.

34846 **(PB—86-156775/XAB) Documentation and analysis for prevention and control of hazardous-material spills. Final report, June 1976-June 1982.** Heard, D.B.; Krasner, L.M.; Vincent, B.G. (Factory Mutual Research Corp., Norwood, MA (USA)). Jan 1986. 565p. NTIS, PC A24/MF A01.

Prevention and control of a problem as complex as that of hazardous material spills and their ensuing effects on the population and environment can only be approached based on a comprehensive reliable system for spill incident collection and analysis. The

groundwork for such a system was established in a previous program, EPA-600/2-78-066 dated April 1978 Hazardous Material Spills: A Documentation and Analysis of Historical Data. The present program developed a detailed spill data base and a completely computerized system for producing reports upon request, with the further capability of generating statistics on any or all spill incidents which are encoded in computer storage. Two logically linked data sets were established. The first set is comprised of incident-related data, while the second is comprised of material-related data. The previously developed computer codes were modified due to the large number of incidents acquired, and to accomodate this dual data base system. New coding techniques also minimize the potential of multiple entries and greatly increase the amount of information that can be stored. These charges have made the data system more nearly universal, providing a more accessible means of retrieving information than was possible using previous retrieval methods.

34847 **(PB—86-157096/XAB) Effects of harvesting cypress swamps on water quality and quantity.** Ewel, K.C. (Florida Univ., Gainesville (USA). Water Resources Research Center). Sep 1985. 62p. (FL/WRRC/PUB—87). NTIS, PC A04/MF A01.

The responses of cypress swamps to a spectrum of harvest techniques are being studied in the Withlacoochee State Forest, Hernando County, Florida. Among the 11 swamps in the study area, four contain plots that were harvested experimentally in 1984. Stand improvement cuts were made in plots in two large swamps. Measurements of tree biomass were made in all but two of the large swamps. The swamps were surveyed for cone production in the fall and regeneration in the spring. However, coppice was produced in all the harvested plots. These preliminary results suggest that coppice production may be a dependable regeneration method, although it may not be desirable for stand improvement cuts and thinning. Evapotranspiration from three cypress swamps averaged 79 cm over a 3-year period. The purpose of this project was to determine specific impacts of harvesting on water quality and water loss rates in the study areas.

34848 **(PB—86-157120/XAB) Mercury mobilization and biomagnification resulting from the filling of a Piedmont reservoir.** Abernathy, A.R. (Clemson Univ., SC (USA). Water Resources Research Inst.). Sep 1985. 71p. (WRRI—119). NTIS, PC A04/MF A01.

Mercury contained in flooded soil and vegetation can be mobilized upon flooding of a new reservoir. The mobilized mercury is accumulated by fish in the new reservoir, and concentrations of total mercury in muscle tissue of predatory fish such as largemouth bass, yellow perch, and other piscivorous species is likely to exceed 1.0 ppm within the first two years after the reservoir fills. The concentrations of total mercury in Russell Reservoir (South Carolina) water were found to be less than in the Savannah River before impoundment, but the total mass of mercury in the impounded water was greater than could be accounted for by that brought in via the inflowing water. Concentrations of total mercury in fish continued to increase during the first 18 months after closure of the dam.

34849 **(PB—86-158268/XAB) Assessment of the toxicity and mutagenic potential of water of Torch Lake, Houghton County, Michigan.** Keen, R.E.; Bagley, S.T.; Barth, A.K. (Michigan Technological Univ., Houghton (USA). Dept. of Biological Sciences). Aug 1985. 39p. NTIS, PC A03/MF A01.

The toxicity and mutagenic potential of water of Torch Lake, Houghton County, Michigan was measured. Torch Lake is unusual in having very large levels of dissolved copper in its water due to deposition of large amounts of spent copper are (stamp sands) in over 100 years of copper-mining activity. The presence of liver neoplasms in 100% of a species of fish (saugar) from Torch Lake has been presumptively associated with some features, probably chemical, of the massive stamp sand deposits in the lake. Because both toxicity and mutagentic potential of the lake water would be most evident at the upper end of the food chains due to bioaccumulation of materials dissolved in the water, tests for these effects were conducted with concentrates of water samples from Torch Lake, and from Otter Lake (Houghton County, Michigan) as a control. Water samples were collected at four different times in the lakes annual thermal cycle, from three depths in Torch Lake and one depth in Otter Lake. The samples were filtered and concentrated using both low temperature evaporation and XAD-2 resin. Toxicity was measured using the Ceriodaphnia 7-day life-cycle chronic toxicity test. Mutagentic potential was measured using the Ames Salmonella/microsome mutagenicity assay (Ames Test).

34850 **(PB—86-158813/XAB) National Marine Pollution Program: federal plan for ocean pollution research, development, and monitoring, Fiscal Uears 1985-1989.** (National Marine Pollution Program Office, Rockville, MD (USA)). Sep 1985. 374p. NTIS, PC A16/MF A01.

The National Marine Pollution Program is the composite of all programs funded by the Federal Government that conduct research, development, or monitoring activities related to marine pollution. In FY 1985, the Program consisted of about 650 projects with a total Federal expenditure of about $122.7 million. These projects were funded by eleven Federal departments and independent agencies and included studies pertaining to pollution in coastal areas, estuaries, open oceans, and the Great Lakes. This plan is intended to guide and coordinate the overall Federal effort in marine pollution research, development, and monitoring during FY 1985-1989 and represents the third such document in the continuing interagency planning process called for in the National Ocean Pollution Planning Act of 1978 (P.L. 95-273), as amended. As required by the Act, this plan identifies and establishes priorities for national marine pollution needs and problems.

34851 **(PB—86-165727/XAB) Contamination of ground water by toxic organic chemicals.** (Council on Environmental Quality, Washington, DC (USA)). Jan 1981. 107p. NTIS, PC A06/MF A01.

Ground water is a vast natural resource of economic importance to agriculture, industry, and everyday life. Approximately one-half of all U.S. residents rely on ground water -- often not treated or disinfected -- as their primary source of drinking water. In sections of the Midwest, the use of agricultural fertilizers has sometimes raised nitrate concentrations in ground waters above federal health standards, and in the Snow Belt, hundreds of wells have been closed because of high concentrations of salt percolating into ground water from de-icing agents used on highways.

34852 **Mechanisms of hydrogen ion neutralization in an experimentally acidified lake.** Cook, R.B.; Kelly, C.A.; Schindler, D.W.; Turner, M.A. (Oak Ridge National Lab., TN). *Limnology and Oceanography;* **31**: No. 1, 134-148(Jan 1986).

The experimental acidification of Lake 223 (Experimental Lakes Area, northwestern Ontario) with sulfuric acid in 1976-1983 allowed a detailed examination of the capacity of the lake to neutralize hydrogen ion. A whole-lake alkalinity and ion budget for Lake 223 showed that 66-81% of the added sulfuric acid was neutralized by alkalinity production in the lake. Nearly 85% of in situ alkalinity production was accounted for by net loss of sulfate through bacterial sulfate reduction, coupled with iron reduction and iron sulfide formation, in littoral sediments (60%) and in the hypolimnion (25%). Exchange of hydrogen ion for calcium and manganese in the sediments accounted for 19% of the alkalinity generated, while other cations were net sinks for alkalinity. The seasonal production of 1000 μeq liter^{-1} alkalinity in the anoxic hypolimnion of this soft-water lake could be attributed to bacterial sulfate reduction coupled with iron sulfide formation, ammonium production, and iron (II) production. Only the alkalinity produced from bacterial sulfate reduction coupled with iron sulfide formation remained throughout the annual cycle.

34853 **Environmental fate modeling on a microcomputer.** Aaberg, R.L.; Peloquin, R.A. (Pacific Northwest Lab., P.O. Box 999, Richland, WA 99352). pp 7183 of Computer applications in health physics. Kathren, R.L.; Higby, D.P.; McKinney, M.A. Richland, WA; Health Physics Society (1984). (CONF-840202—). Contract AC06-76RL01830.

From 17. midyear topical meeting of the Health Physics Society; Pasco, WA, USA (5 Feb 1984).

Mathematical models of ecosystems can be implemented on microcomputers reducing development, maintenance and execution costs, and increasing user convenience. A multicompartmental model entitled Aquatic Pathways Model of Toxic Chemicals (APM) was designed to describe the transport and fate of phenolic compounds present in energy-related materials introduced into a flowing or static aquatic environment. Processes modeled included uptake and clearance by fish, adsorption by sediments, volatilization and degradation. APM was developed using methods of computer code design, structure and optimization that allow complex compartment models to be implemented on microcomputers. The computer implementation of the eight compartment model demonstrated an efficient use of memory by partitioning and overlaying code segments, maintaining data base and using disk files.

5203 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 33838, 33841, 33847, 33848, 33850, 33851, 33852, 34034, 34785, 34792, 34815, 34824

34854 (INIS-mf—9886) State Authority for Water and Waste Management of North-Rhine Westphalia. Annual report '84. (Landesamt fuer Wasser und Abfall Nordrhein-Westfalen, Duesseldorf (Germany, F.R.)). Jan 1985. 53p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE86752052.

The annual report gives information on PR, literature and results from: 1. Measuring radioactivity in the Rhine, 2. problems of dioxin analysis, 3. Danger from waste dump gas and how to use it, 4. problems of residues from flue gas cleaning. Three articles of this report have been documented separately. (PW).

34855 (INIS-mf—9886, pp 12-16) **Radioactivity in the Rhine - the LWA controls North-Rhine-Westphalian surface waters.** Kloes, H. Jan 1985. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE86752052.

In State Authority for Water and Waste Management of North-Rhine Westphalia. Annual report '84.

The State Authority for Water and Waste Management has been testing the Rhine and the most important surface waters of North-Rhine Westphalia for radioactivity ever since it was founded in 1969. Radiation exposure of human beings who use Rhine water is far below the permitted maximum values of the 'radiation protection ordinance'. Pollution of the Rhine and its tributaries in North-Rhine Westphalia with artificial radioactive substances has even slightly decreased over the past ten years; pollution of the River Emscher with natural radioactive material remained high, the Lippe River now contains less radium than before.

34856 (INS-R—316) Carbon-14, tritium, stable isotope and chemical measurements on thermal waters from the Tauranga region. Stewart, M.K.; McGill, R.C.; Taylor, C.B.; Whitehead, N.E.; Downes, C.J. (Department of Scientific and Industrial Research, Lower Hutt (New Zealand). Inst. of Nuclear Sciences; Department of Scientific and Industrial Research, Lower Hutt (New Zealand). Div. of Chemistry). Mar 1984. 25p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86702157.

The chemical compositions of groundwater from the Tauranga region are affected to varying degrees by reducing conditions due to buried organic matter. The levels of some dissolved constituents are also affected by mixing with sea water contained within the rocks and by rock-water interaction. Dissolved gas compositions range from oxygen-bearing to methane-bearing reflecting the varying redox conditions. Excess air may be present but further experiments are necessary to confirm this. Apparent ages deduced from carbon-14 measurements (corrected using 12C dilution and 13C fractionation methods) range from 2-25,000 years, suggesting that some of the waters were recharged during late Pleistocene or early Holocene time. ΔD and Δ18 O values of the oldest waters are slightly more negative than those of younger samples; this may indicate recharge during a cooler climate, in agreement with the 14C ages. Very low but significantly non-zero tritium contents (TR=(0.007-0.059) +- 0.007) were measured using the high tritium-enrichment facilities at INS and the very low-background counters at the University of Bern. The tritium is thought to derive from contamination or nuclear reactions in the aquifer rocks rather than from recharge water.

34857 (PB—86-142320/XAB) Concentrations and concentration factors of several anthropogenic and natural radionuclides in marine vertebrates and invertebrates. Final report. Noshkin, V.E. (Lawrence Livermore National Lab., CA (USA)). 17 Jul 1985. 98p. (UCRL—91765). NTIS, PC A05/MF A01.

Literature is reviewed and summarized with regard to concentrations of several anthropogenic and natural radionuclides in biological organisms from marine environments. Reported concentration factors for these radionuclides in organisms are tabulated for marine fish and invertebrates from water masses affected by different source terms.

34858 (RCM—02085) Basic actinide and fission products chemistry in the CEC-coordinated project: Migration of radionuclides in the geosphere (MIRAGE). Kim, J.I. (Technische Univ. Muenchen, Garching (Germany, F.R.). Inst. fuer Radiochemie). May 1985. 43p. NTIS (US Sales Only), PC A03/MF A01. File Number DE86751410.

The paper reviews the research works performed on the basic actinide (Am, Pu, Np) and fission product (Tc, Sr) chemistry by four CEC member laboratories under the project named 'MIRAGE' for the years 1983 and 1984. Research subjects dealt with are solubility, carbonate complexation, hydrolysis reaction, colloid generation, speciation methods and sorption phenomena. Important achievements are summarized and discussed for each subject separately. (orig.).

34859 (UCID—20308) Biogeochemical studies of long-lived radionuclides in marine environments. Noshkin, V.E.; Wong, K.M.; Eagle, R.J.; Jokela, T.A. (Lawrence Livermore National Lab., CA (USA)). Jan 1985. Contract W-7405-ENG-48. 11p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86010783.

Research results from several studies relevant to seabed disposal of radioactive wastes are briefly discussed. The studies include: (1) mobilization of plutonium from Enewetak and Bikini lagoon sediments to seawater; (2) concentrations of ^{90}Sr, ^{137}Cs, / sup 239+240/Pu, ^{241}Am, ^{207}Bi and ^{210}Pb-^{210}Bi-^{210}Po in fish from the Marshall Islands; and (3) plutonium in northeast Atlantic sediments. (ACR)

5204 Thermal Effluents Monitoring And Transport

34860 (EPRI-CS—4320) Hydrothermal performance of vertically stratified cooling ponds. Final report. Luxenberg, R.R.; Adams, E.E. (Massachusetts Inst. of Tech., Cambridge (USA)). May 1986. 135p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920292.

Experiments in a three dimensional physical model in a laboratory were conducted to analyze the hydrothermal performance of deep vertically stratified cooling ponds. Temperature, velocity and fluorescent dye data were collected. Particular attention was paid to identifying discharge structures which minimize entrance mixing and to identifying the sensitivity of steady state and transient pond performance to intake location. The relative importance of far field mixing mechanisms was also estimated. Results were compared to previous experiments.

5205 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 33888, 33889, 34833

34861 (DPST—84-555) Compilation of historic water quality data base. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 19 Jun 1984. Contract AC09-76SR00001. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86010318.

Per commitments outlined in the Comprehensive Cooling Water Study (CCWS) Scope of Work document and Water Quality Technical Plan, a historical data base of nonradiological water chemistry data from onsite streams and the Savannah River was compiled and subjected to statistical analysis. The historic water quality data were entered into a SAS data base maintained by the Environmental Sciences Division of SRL. The purpose of the data base compilation was to evaluate long-term trends in water quality at onsite streams and Savannah River sampling locations. All nonthermal water quality stations were consistently in compliance with South Carolina Class B stream water classification standards. In addition, a great deal of water chemistry similarity was evidenced for most constituents among the various stations in SRP onsite streams and the Savannah River.

34862 **(DPST—85-611) SRP surface water system: hydrology, quality and use.** (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 26 Jun 1985. Contract AC09-76SR00001. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010317.

Environmental studies for inclusion in Environmental impact statement address surface waters of SRL. (PSB)

34863 **(PB—86-157286/XAB) Wetland trends and protection programs in Nebraska.** (Nebraska Univ., Lincoln (USA). Great Plains Office of Policy Studies). Sep 1982. 154p. NTIS, PC A08/MF A01.

The report is one of ten regional case studies that was funded by the Office of Technology Assessment (OTA) of the U.S. Congress for use in its study, Wetlands: Their Use and Regulation.

5206 Regulations

34864 **(PB—86-161452/XAB) Development document for effluent limitations guidelines and standards for metal molding and casting (foundries). Point source category. Final report.** Anderson, D. (Environmental Protection Agency, Washington, DC (USA). Industrial Technology Div.). Oct 1985. 644p. (EPA/440/1—85/070). NTIS, PC A99/MF A01.

The Development Document describes the technical basis for final regulations (see the Federal Register for October 30, 1985, at 50FR v 45212) that establish effluent limitations guidelines and standards that limit the discharge of pollutants into navigable waters and publicly owned treatment works (POTWs) by existing and new sources engaged in metal molding and casting operations. The Development Document sets forth the effluent limitations guidelines achievable by the best practicable control technology currently available (BPT), the best available technology economically achievable (BAT), new source performance standards (NSPS) attainable by the best available demonstrated technology, and pretreatment standards applicable to existing and new discharges to POTWs (PSES and PSNS, respectively).

53 ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

34865 **(GAO/RCED—86-82BR) Water resources. Issues concerning expanded irrigation in the Columbia Basin project.** (General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div.). Jan 1986. 25p. US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877. File Number TI86901401.

Briefing report to the Chairmen, Subcommittees on General Oversight, Northwest Power, and Forest Management, and on Water and Power Resources, House Committee on Interior and Insular Affairs.

The Bureau of Reclamation of the Department of the Interior in a 1984 report on the project estimated that this expansion could cost $1.9 billion and that the project's benefits outweighed its costs. We reviewed studies and reports on possible expansion of the project issued in 1984 and 1985 by the Bureau, faculty members of Washington State University and the University of Idaho, and a consulting firm for the Washington State Department of Ecology. We found that the Bureau's 1984 benefit/cost analysis did not conform to the Water Resources Council's Principles and Guidelines for preparing such analyses. As a result, the costs were understated and the benefits overstated.

5301 Social And Economic Studies

REFER ALSO TO CITATION(S) 33701

5302 Assessment Of Energy Technologies

REFER ALSO TO CITATION(S) 34862

55 BIOMEDICAL SCIENCES, BASIC STUDIES

REFER ALSO TO CITATION(S) 35207

5502 Biochemistry

REFER ALSO TO CITATION(S) 34944

34866 (LMF—114, pp 156-160) **Distribution of the FAD-containing monooxygenase in respiratory tract tissues.** Sabourin, P.J.; Dahl, A.R. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

Microsomes were isolated from the respiratory tract tissues of New Zealand White Rabbits, and the FAD-containing monooxygenase (FMO) activity was determined using thiobenzamide as the substrate. Pleural and subpleural lung parenchyma, central parenchyma and small airways, major lung airways, and carina contained specific activities of FMO similar to those seen in the liver. Of the nasal tissues studied, the nasal epithelium and the ethmoturbinates, but not the maxilloturbinates, contained high specific activities of FMO. Trachea and larynx contained no detectable FMO activity, and the epithelium of the nasopharynx did not yield sufficient quantities of microsomes for analysis. The FMO activity appeared to be quite stable during the postmortem isolation procedure. 6 references, 1 table.

34867 **(UCRL—94305) Recent progress with the DNA repair mutants of Chinese hamster ovary cells.** Thompson, L.H.; Salazar, E.P.; Brookman, K.W.; Collins, C.C.; Stewart, S.A.; Busch, D.B.; Weber, C.A. (Lawrence Livermore National Lab., CA (USA)). 2 Apr 1986. Contract W-7405-ENG-48. 31p. (CONF-8604183—1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86010564.

From Conference on molecular biology of DNA repair; Manchester, UK (16 Apr 1986).

Repair deficient mutants of Chinese hamster ovary (CHO) cells are being used to identify human genes that correct the repair defects and to study mechanisms of DNA repair and mutagenesis. Five independent tertiary DNA transformants were obtained from the EM9 mutant. In these clones a human DNA sequence was identified that correlated with the resistance of the cells to CldUrd. After Eco RI digestion, Southern transfer, and hybridization of transformant DNAs with the BLUR-8 Alu family sequence, a common fragment of 25 to 30 kb was present. 37 refs., 4 figs., 3 tabs.

34868 **Purification and characterization of ribulose-5-phosphate kinase from spinach.** Porter, M.A.; Milanez, S.; Stringer, C.D.; Hartman, F.C. (Oak Ridge National Lab., TN). *Archives of Biochemistry and Biophysics;* No. 1, 14-23(15 Feb 1986).

An efficient purification procedure utilizing affinity chromatography is described for spinach ribulose-5-phosphate kinase, a light-regulated chloroplastic enzyme. Gel filtration and polyacrylamide gel electrophoresis of the purified enzyme reveal a dimeric structure of 44,000 Mr subunits. Chemical crosslinking with dimethyl suberimidate confirms the presence of two subunits per molecule

of native kinase, which are shown to be identical by partial NH2-terminal sequencing. Based on sulfhydryl titrations and on amino acid analyses, each subunit contains four to five cysteinyl residues. The observed slow loss of activity during spontaneous oxidation in air-saturated buffer correlates with the intramolecular oxidation of two sulfhydryl groups, presumably those involved in thioredoxin-mediated regulation.

5503 Cytology

34869 (LMF—114, pp 374-376) **Characterization of lymphocyte subsets in bronchoalveolar lavage and blood of monkeys using an immunoenzymatic staining technique.** Mason, M.J.; Bice, D.E. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

Percentages of T-helper/inducer (OKT4), T-suppressor/cytotoxic (OKT8), and B(B1) lymphocytes were determined in peripheral blood and bronchoalveolar lavage (BAL) fluid from six cynomolgus monkeys. Cellular antigens were detected using an alkaline phosphatase-based immunoenzymatic staining technique. The percentages of cell types in BAL were: 40 +/- 9%, 26 +/- 7% and 11 +/- 4% for OKT4, OKT8, and Bl, respectively. This cell distribution is similar to that obtained from normal human BAL samples. Percentages of each subset in blood and BAL were similar. The advantage of the immunoenzymatic staining technique is that it allows for identification of lymphocytes without having to first separate these cells from macrophages. The technique can be used in laboratories not equipped for fluorescence microscopy or flow cytometry. 6 references, 1 table.

5505 Metabolism

REFER ALSO TO CITATION(S) 33689, 33741, 34745, 34959, 34962, 34968, 34970, 34979

34870 (LMF—114, pp 79-83) **Comparison of nasal mucociliary clearance and retention of 3-μm microspheres in maxillary and ethmoid turbinates in beagle dogs.** Whaley, S.L.; Wolff, R.K.; Muggenburg, B.A.; Snipes, M.B. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

Radiolabeled polystyrene microspheres, 3 μm geometric diameter, were instilled simultaneously onto the maxillary and ethmoid turbinates in Beagle dogs. The retention and clearance patterns of the microspheres were followed for 30 days after instillation. Mucociliary clearance velocity during the first hour after instillation from the maxillary turbinate region was 2.5 +/- 0.7 mm/min (mean +/- SE) and 0.6 +/- 0.4 mm/min from the ethmoid turbinate region. Retention of microspheres in the turbinates at 30 days after instillation was 0.1% of the initial burden, regardless of instillation site. Radiolabel-associated microspheres were excreted via the feces, with the bulk excreted in the first few days. Autoradiographs of nasal turbinates revealed particles randomly located in the epithelial submucosa. 5 references, 3 figures, 1 table.

34871 (LMF—114, pp 131-134) **Factors modifying lung clearance of inhaled organic compounds.** Henderson, R.F.; Bechtold, W.A.; Medinsky, M.A.; Lee, T. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

The objective of this study was to test the hypothesis that the pulmonary retention of lipid-soluble material is dependent on the molecular weight and/or the lipophilicity of the compound. Results indicated a positive correlation between the molecular weight or the theoretical octanol/water partition coefficient and the percent of an intratracheally instilled compound retained in lung 24 h after instillation. Such information should be useful in predicting the potential for retention in the lung of inhaled organic compounds. 3 references, 2 figures, 2 tables.

34872 (LMF—114, pp 135-138) **Facilitation of removal and metabolism of benzo(a)pyrene from diesel particles by rat lung and liver microsomes.** Leung, H.W.; Henderson, R.F.; Bond, J.A. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

To determine the factors affecting the bioavailability of particle-associated polycyclic aromatic hydrocarbons, the authors have studied the ability of microsomes to facilitate removal of benzo(a)pyrene (BaP) adsorbed on the surface of diesel exhaust soot particles. The results indicated that both rat lungs and liver microsomes were able to facilitate removal of BaP from the surface of diesel particles. The ability to disassociate BaP from diesel particles was independent of metabolism or the presence of protein but related to the lipid content of the microsomes. There was no significant metabolism of the diesel-particle-coated BaP. However, under identical incubation conditions, free BaP was extensively metabolized by microsomes, principally to BaP-9,10-diol. 4 references, 2 figures, 1 table.

34873 (LMF—114, pp 139-143) **Binding, distribution, and clearance of ^{3}H-benzo(a)pyrene-7,8-diol-9,10-epoxide from chromosomes of CHO cells.** Brooks, A.L.; Griffith, W.C. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

The purpose of this study was to determine if the binding of a chemical carcinogen was random both within and between chromosomes. Chinese hamster ovary cells were exposed to ^{3}H-labeled +/- anti[G-^{3}H]-benzo(a)pyrene-7,8-diol-9,10-epoxide (^{3}H-BPDE) and serially harvested. Autoradiographs were prepared and the distribution of silver grains over metaphase chromosomes was determined. The ^{3}H-BPDE was randomly distributed down the length of the chromosome. The ^{3}H-BPDE was rapidly removed from the chromosomes with 6% of the initial label remaining at 9 h after exposure. The distribution of silver grains between chromatids was nonrandom at 3 and 6 h after exposure, suggesting a differential removal of ^{3}H-BPDE. 4 references, 4 figures.

34874 (LMF—114, pp 144-147) **Spectral and structural properties of pulmonary cytochrome P-450 isozymes induced in mouse lungs by benzo(a)pyrene and 3-methylcholanthrene.** Mitchell, C.E.; Sun, J.D.; Dahl, A.R. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

The properties of constitutive and inducible cytochrome P-450 enzymes and the cytochrome P-450 content of lung and liver microsomes were determined in mice pretreated with benzo(a)pyrene (BaP) or 3-methylcholanthrene (3-MC). Lung aryl hydrocarbon hydroxylase (AHH) and 7-ethoxyresorufin O-deethylase were increased after intratracheal instillation of BaP. Only 7-ethoxyresorufin O-deethylase was increased in liver microsomes. Intraperitoneal injection of 3-MC resulted in an increase in liver AHH and 7-ethoxyresorufin O-deethylase. Lung AHH activity was only slightly affected. In lungs or liver, nitroreductase, benzphetamine N-demethylase, and cytochrome P-450 content were unaffected by BaP pretreatment. Data suggested that monooxygenase and nitroreductase activities were functions of different cytochrome P-450 isozymes that were selectively inducible. 6 references, 1 figure, 1 table.

34875 (LMF—114, pp 335-337) **Effect of aging on tracheal mucociliary clearance in Beagle dogs.** Whaley, S.L.; Muggenburg, B.A.; Wolff, R.K. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

Tracheal mucous velocity measurements were made in 24 Beagle dogs, in 5 age groups, using a gamma camera to detect movement on instilled radiolabeled material. Age groups were defined as immature, young adult, middle-aged, mature, and aged dogs. Mean velocities (+/- SE) were 3.6 +/- 0.4 mm/min in the immature dogs, 9.8 +/- 0.7 mm/min in the young adults, 6.9 +/-

0.5 mm/min in the middle-aged dogs, 3.6 +/- 1.1 mm/min in the mature dogs, and 2.8 +/- 0.6 mm/min in the aged dogs. Tracheal mucous velocity was significantly faster in the young adult and middle-aged groups than in the immature, mature, and aged dog groups. 4 references, 1 figure, 1 table.

34876 (LMF—114, pp 338-340) **Nasal mucous velocity in awake and anesthetized Beagle dogs.** Whaley, S.L.; Wolff, R.K.; Muggenburg, B.A. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

Nasal mucous clearance rates in the maxillary turbinate region were measured in a group of eight Beagle dogs. Ten μl of / sup 99m/Tc macroaggreated albumin (/sup 99m/Tc MAA) was instilled in the nasal maxillary region, and scintiphotographs were taken for one hour after instillation. Mucous velocity measurements were made under three conditions: (a) anesthesia with pentobarbital (30 mg/kg body weight), (b) anesthesia with halothane gas, and (c) awake. Mean velocities and standard deviations were 3.7 +/- 1.4 mm/min when anesthetized with pentobarbital, 4.3 +/- 2.5 mm/min when anesthetized with halothane, and 3.4 +/- 1.7 mm/min when awake. The differences among the groups were not significant at the $p \leq 0.05$ level. 4 references, 1 table.

34877 **Starch and sucrose synthesis in Phaseolus vulgaris as affected by light, CO_2, and abscisic acid.** Sharkey, T.D.; Berry, J.A.; Raschke, K. (Desert Research Institute, Reno, NV). *Plant Physiology;* **77**: No. 3, 617-620(Mar 1985).

Phaseolus vulgaris L. leaves were subjected to various light, CO_2, and O_2 levels and abscisic acid, then given a 10 minute pulse of $^{14}CO_2$ followed by a 5 minute chase with unlabeled CO_2. After the chase period, very little label remained in the ionic fractions except at low CO_2 partial pressure. Most label was found in the neutral, alcohol soluble fraction or in the insoluble fraction digestable by amyloglucosidase. Sucrose formation was linearly related to assimilation rate. Starch formation increased linearly with assimilation rate, but did not occur if the assimilation rate was below 4 micromoles per square meter per second. Neither abscisic acid, nor high CO_2 in combination with low O_2 caused significant perturbations of the sucrose/starch formation ratio. These studies indicate that the pathways for starch and sucrose synthesis both are controlled by the rate of net CO_2 assimilation, with sucrose the preferred product at very low assimilation rates.

34878 **Characteristics of alveolar macrophages following the deposition of a low burden of iron oxide in the lung.** Lehnert, B.E.; Morrow, P.E. (Univ. of Rochester, NY). *Journal of Toxicology and Environmental Health;* **16**: No. 6, 855-868(1985). Contract AC02-76EV03490.

Rats were exposed to aerosols of iron-59 oxide (mass median aerodynamic diameter, MMAD = 1.6 μm, σ/sub g/ = 3.0) at a nominal concentration of 20 mg/m³ for 2 h to determine how a low lung burden (~30 μg) of innocuous particles affects the size of the alveolar macrophage (AM) pool. The functional status of the AM was also determined as assessed in vitro by their ability to exclude Trypan blue, adhere to plastic substrate, and bind phagocytize sheep erythrocytes opsonized with immunoglobulin G (SRBC-IgG). Iron oxide deposition did not bring about significant changes in cell types or numbers of AM lavaged, AM viabilities, or the plastic substrate adherence characteristics of the AM. As of 1 d post exposure, however, the ability of AM to phagocytize SRBC-IgG increased. Phagocytosis was maximally enhanced 3-7d post exposure and returned to control levels by 20 d after exposure. The increase in phagocytic activity correlated with an increase in AM avidities for SRBC-IgG. The kinetics of subsidence of the phagocytic response did not parallel the alveolar clearance rate of the deposited particles [t/sub 1/2/ (biol) 53 d]. These studies show the deposition of a low lung burden of a noncytotoxic dust can transiently enhance FCγ-receptor-mediated particle binding and phagocytosis by AM.

5506 Medicine

REFER ALSO TO CITATION(S) 34479, 34491

34879 **(FNAL-TM—1295) Proton beam therapy facility.** (Fermi National Accelerator Lab., Batavia, IL (USA)). 9 Oct 1984. Contract AC02-76CH03000. 56p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86010782.

It is proposed to build a regional outpatient medical clinic at the Fermi National Accelerator Laboratory (Fermilab), Batavia, Illinois, to exploit the unique therapeutic characteristics of high energy proton beams. The Fermilab location for a proton therapy facility (PTF) is being chosen for reasons ranging from lower total construction and operating costs and the availability of sophisticated technical support to a location with good access to patients from the Chicago area and from the entire nation. 9 refs., 4 figs., 26 tabs.

34880 (INIS-mf—10105, pp 96) **Rapid data-acquisition techniques for NMR imaging.** Starcuk, Z.; Bartusek, K.; Starcuk, Z. Jr. (Ceskoslovenska Akademie Ved, Brno. Ustav Pristrovoje Techniky). 1984. NTIS (US Sales Only), PC A02/MF A01. File Number DE86702155. (CONF-8406249—Vol.2-Absts.).

From 7. Czechoslovak spectroscopic conference and 8. CANAS; Ceske Budejovice, Czechoslovkia (18 Jun 1984).

34881 (KAERI/RR—450-1/84, pp 59-92) **Studies on tumor with cyclotron produced radionuclides. Studies on tumor localization of ^{99}mTc-liposomes.** Lee, C.H.; Kang, T.W.; Ryu, Y.W.; Kim, J.W.; Wu, K.S.; Chung, W.S. (Korea Advanced Energy Research Inst., Daeduk, Republic of Korea; Cancer Research Hospital, Seoul, Republic of Korea). Apr 1985. (In Korean). NTIS (US Sales Only), PC A08/MF A01. File Number DE86780466.

In Studies on the safety assessment for environmental radiation and radioactivity (II).

Our labolatory investigated which liposomes labelled with short lived radioisotopes such as ^{67}Ga, ^{111}In and ^{99}mTc were the most effective on tumor seeker in 1983. It was considered that applied techniques of radionuclides at present contributed greatly in the field of nuclear medicine. Korean Cancer Center Hospital Cyclotron 50 MC-PF operated for the first time in our country in 1984 and is planning to the diagnostics and basic research projects of cancer. In 1984, our goal was to drive for development to prepare radiopharmaceuticals which were labelled with short lived radionuclides such as ^{67}Ga, ^{111}In, ^{169}Yb, ^{51}Cr produced by cyclotron and ^{99}mTc produced by reactor. The purpose of research is to examine the safety control for labelling reaction between liposomes and radioactive metal ions and to develop basic researches by adding calculating agents such as EDTA, DPTA, and NTA into ^{99}mTc labelled for diagnostic imaging agents.

34882 (KAERI/RR—450-1/84, pp 93-136) **Studies on tumor with cyclotron produced radionuclides. Studies on malignant tumor with cyclotron produced ytterbium-169, chrome-51 and cobalt-57.** Lee, C.H.; Kang, T.W.; Ryu, Y.W.; Kim, J.W.; Wu, K.S.; Chung, W.S. (Korea Advanced Energy Research Inst., Daeduk, Republic of Korea; Cancer Research Hospital, Seoul, Republic of Korea). Apr 1985. (In Korean). NTIS (US Sales Only), PC A08/MF A01. File Number DE86780466.

In Studies on the safety assessment for environmental radiation and radioactivity (II).

^{169}Yb-citrate and ^{51}Cr-, ^{57}Co-BLM show high affinity for the sarcoma 180 tumor and the concentration value in the tumor tissue of ^{169}Yb-citrate is highest, being 3.69%/mg after 48 hours. To compare the distribution in vivo of ^{67}Ga- and ^{169}Yb-citrate, the concentration of ^{169}Yb-citrate in the tumor tissue was similar to that of ^{67}Ga-citrate and in the liver and spleen was less than that of ^{67}Ga-citrate, whereas accumulation in the bones was almost three times that of ^{67}Ga. ^{57}Co-BLM, which is stable in vivo, appears to yield the most consistent results, although the long half-life of ^{57}Co is a practical disadvantage. Possible clinical uses of ^{169}Yb-citrate and ^{51}Cr-, ^{57}Co-BLM for tumor diagnosis were suggested.

34883 (LMF—114, pp 341-343) **Alteration of gastrointestinal transit time in the rat after bile duct cannulation surgery.** Ayres, P.H.; Medinsky, M.A.; Muggenburg, B.A.; Bond, J.A. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

Alteration of gastrointestinal (GI) transit time could affect the bioavailability of a toxicant if the toxicant is absorbed in the GI tract. The effect of surgery on GI transit time was investigated using radiographic imaging of barium during passage through the GI tract of the rat. Bile duct cannulation surgery delayed transit of barium to over 18 h, whereas in the normal animal, transit required approximately 6 h. GI transit time was only moderately affected by laparotomy after an 18-h postsurgery recovery period. These results suggest that the gastrointestinal absorption of orally administered toxicants could be affected by bile duct cannulation. 3 references, 1 figure, 1 table.

34884 **(PB—86-937600/XAB) Cancer detection and management: nuclear medicine. Cancergram CT02.** (National Cancer Inst., Bethesda, MD (USA). International Cancer Research Data Bank). 1986. vp. NTIS.

Subscription.

The Cancergram covers all aspects of the clinical use of radionuclides or nuclear medicine techniques in the care of cancer patients. It also includes any preclinical studies of various radionuclides or techniques considered to have direct clinical diagnostic relevance. Other basic biologic, pharmacologic, or metabolic studies where radionuclides are used as tracers will generally be excluded. Radiotherapy is covered by Cancergram CT15, and Diagnostic Radiology by Cancergram CT14.

34885 **(PB—86-939000/XAB) Clinical treatment of cancer: radiation therapy. Cancergram CT15.** (National Cancer Inst., Bethesda, MD (USA). International Cancer Research Data Bank). 1986. vp. NTIS.

Subscription.

The Cancergram covers all forms of radiotherapy being used in the treatment of cancer, including standard x-ray, cobalt 60 and radium irradiation as well as high linear energy transfer (LET), megavoltage, electron beam treatment, and radioactive interstitial implants. Coverage of this topic includes adverse effects of radiotherapy, radiocurability, radiodosimetry, radiosensitization, and study with specialized instrumentation such as the betatron and linear accelerator. Radiobiology, animal experiments, tissue culture experiments, carcinogenesis, and other preclinical studies will not be included except for those considered to have direct clinical relevance.

34886 **Point sensitive NMR imaging system using a magnetic field configuration with a spatial minimum.** Eberhard, P. H. (to The United States of America as represented by the United States Department of Energy.). US Patent 4,556,848. 3 Dec 1985. Filed date 1 Feb 1983. vp.

PAT-APPL-462816.

A point-sensitive NMR imaging system in which a main solenoid coil produces a relatively strong and substantially uniform magnetic field and a pair of perturbing coils (PZ1 and PZ2) powered by current in the same direction superimposes a pair of relatively weak perturbing fields on the main field to produce a resultant point of minimum field strength at a desired location in a direction along the Z-axis. Two other pairs of perturbing coils (PX1, PX2; PY1, PY2) superimpose relatively weak field gradients on the main field in directions along the X- and Y-axes to locate the minimum field point at a desired location in a plane normal to the Z-axes. An RF generator irradiates a tissue specimen in the field with radio frequency energy so that desired nuclei in a small volume at the point of minimum field strength will resonate.

34887 **In-vivo measurement of lithium in the brain and other organs.** Vartsky, D.; Cohn, S. H.; Ellis, K. J.; LoMonte, A. F.; Wielpolski, L. (to The United States of America as represented by the Department of Energy). US Patent 4,556,068. 3 Dec 1985. Filed date 26 Aug 1983. vp.

PAT-APPL-526762.

The lithium used clinically and distributed in organs such as the brain or kidney of humans and other exhaling animals is determined in-vivo by means of neutron radiation and measuring in the exhaled air elemental tritiated hydrogen released from the tritium reaction by the reaction $_6Li(n,a)T$. The tritium atoms so released are transformed in part in the surrounding aqueous solution to form gaseous tritiated hydrogen which has a small solubility in body tissues and liquids and thus appears quickly in the breath. After a recipient fasts and is irradiated with neutrons, the air exhaled in the breath for a given time after irradiation is captured and processed to remove water, isolate hydrogen and measure the tritiated hydrogen with a gaseous organ-methane counter.

34888 **Dosimetry in neutron therapy by automatic readout of CR-39 SSNTDs.** Blue, T.E.; Wepprecht, C.S.; Blue, J.W.; Roberts, W.K.; Wehring, B.W. (Ohio State Univ., Columbus). *Transactions of the American Nuclear Society;* **50**: 434-435(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

The goal of this research is to develop the solid-state nuclear track detector (SSNTD) CR-39 as a neutron dosimeter for in vivo measurements of neutron doses in fast neutron radiotherapy. The dosimetry system (track area analysis system), consisting of CR-39 detectors and an automatic image analyzer, is analogous to a pulse-height analysis system using an ion chamber and a multichannel analyzer. By following simple procedures, which are common practice for pulse-height analysis systems, a track area analysis system should produce consistent results. This paper describes the effect on the measured CR-39 sensitivity of varying track-counting parameters that most nearly reproduce the sensitivity reported previously for manual track counting.

34889 **Comparison of 68Ga-EDTA, [1-11 C]alpha-aminoisobutyric acid, and [99mTc]sodium pertechnetate in an experimental blood-brain barrier lesion.** Washburn, L.C.; Blair, L.D.; Byrd, B.L.; Sun, T.T. (Oak Ridge Associated Universities, TN). *International Journal of Nuclear Medicine and Biology;* No. 4, 267-269(1985).

Unilateral opening of the blood-brain barrier (BBB) in rats, induced by infusion of a hyperosmotic solution of mannitol into the left internal carotid artery, was applied to compare 68Ga-EDTA, [1-11C]alpha-aminoisobutyric acid (using the long-lived 14C-labeled analog), and [9mTc]sodium pertechnetate as agents for diagnosis of BBB disruption. Of the three agents and two time intervals studied, 68Ga-EDTA at 30 min postinjection gave the highest target-to-nontarget ratio. In addition, 68Ga-EDTA, unlike commonly used [99mTc]sodium pertechnetate, can be used in conjunction with positron emission tomography, which could make possible earlier and better assessment of BBB defects using 68Ga-EDTA.

5507 Microbiology

34890 (EUR—9990-EN, pp 1-78) **Pt. I: The cultivation of large brown coal algae as an energy crop.** Jones, J.M.; Holt, T.J. (Liverpool Univ., UK. Dept. of Marine Biology; Nottingham Univ., UK. Wolfson Inst. of Interfacial Technology). 1985. NTIS (US Sales Only), PC A06/MF A01.

Energy.

In Part I: The cultivation of large brown coal algae as an energy crop. - Part II: Biomass from offshore sea areas of Europe.

The main aim of the work was to develop a method of cultivating large brown algae in the open sea. This was successfully achieved using Alaria esculenta and Laminaria saccharina. A third species, Saccorhiza polyschides, was found to be less suitable. Cultivation took place on horizontal ropes suspended 1-10 m below the sea surface. A simple system of buoys and weights proved effective in maintaining the depth of the ropes. The system usually survived winter storms. The method involved culture of the young stages of the plants on string under controlled conditions, usually for 20-40 days. Short lengths of the string were then inserted into the rope in the sea during winter and spring. Groups of plants grew both on the string and on the rope itself at the point of attachment. The plants grew rapidly during spring and early summer. Winter seeded Alaria stopped growing in late May/early June, while spring

seeded plants continued to grow until mid July. Laminaria continued to grow until early September when it was harvested. In both species production was higher in winter seeded plants than in spring seeded ones. A depth of 2 m was found to be suitable for growth of winter seeded plants. By seeding at depths of 3, 5 and 10 m (the latter rope raised to 2 m after 6 weeks) diatom growth was inhibited, resulting in increased survival of spring seeded plants, but production was still lower than from winter seeded ones. Production levels of 1.1 kg dry weight/m of rope by 10 groups of Alaria seeded at 5 cm intervals and 2.8 kg dry weight/m of rope by 5 groups of Laminaria seeded at 10 cm intervals were obtained. There were indications that these levels could be substantially increased by seeding the plants at very high densities. (orig./EF).

34891 **Method for detection of microorganisms that produce gaseous nitrogen oxides.** Jenneman, G.E.; Montgomery, A.D.; McInerney, M.J. (Univ. of Oklahoma, Norman). *Applied and Environmental Microbiology;* **51**: No. 4, 776-780(Apr 1986). Contract AS05-83ER13053.

A method was developed to detect NO- or N_2O-producing bacteria in solid or liquid medium by their ability to oxidize the redox indicator resazurin from its reduced colorless form to its oxidized pink form. The method was sensitive to as little as 35 nM N_2O or 0.5 nM NO. Ninety-one percent of the colonies that oxidized resazurin on plates also produced N_2O. This percentage was reduced to 15% when colonies in which the coloration was difficult to discern were picked to slants to determine whether they oxidized the slant. The production of N_2O preceded the oxidation of resazurin by liquid cultures of Escherichia coli and a sludge isolate. With the denitrifying sewage isolate, the disappearance of N_2O was followed by the return of resazurin to its reduced state. Wolinella succinogenes was found to produce small amounts of N_2O from NO_3^-, which resulted in a transient oxidation of resazurin.

34892 **Effects of long-term preservation of Frankia strains on infectivity, effectivity, and in vitro nitrogenase activity.** Fontaine, M.S.; Young, P.H.; Torrey, J.G. (Harvard Univ., Petersham, MA). *Applied and Environmental Microbiology;* **51**: No. 4, 694-698(Apr 1986). Contract FG02-84ER13198.

Frankia strain HFP ArI3 which had been preserved for 27 months by being lyophilized, frozen in glycerol, or stored in complex medium was successfully used as an inoculum after being subcultured for inducing nodulation and nitrogen fixation of Alnus rubra. Glycerol-preserved HFPArI3 produced significantly lower rates of nitrogenase activity than did lyophilized or complex-medium-preserved inocula. Bacteria that had been preserved by all three methods were successfully induced to fix atmospheric nitrogen by being cultured in nitrogen-free medium. Subculturing of these cells in nitrogen-free medium a second and third time yielded increasing rates of nitrogenase activity. Initial nitrogenase activity was detected on days 5, 4, and 3 during the first, second, and third subcultures after preservation, respectively. Maximum activity was observed on days 11, 10, and 8 during the first, second, and third subcultures, respectively. A description is given of standard culture techniques used in our laboratory for Frankia isolates, and methods used to distribute Frankia cultures by mail are described.

5509 Pathology

REFER ALSO TO CITATION(S) 34768, 34963, 34964, 34965, 34966, 34967

34893 (LMF—114, pp 354-358) **Role of leukotriene B_4 in lung inflammation.** Shopp, G.M.; Fink, M.E.; Mason, M.J.; Henderson, R.F.; Bice, D.E. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

To evaluate the role of leukotriene B_4 (LTB) as a mediator of lung inflammation, rats and dogs were instilled with LTB, the lungs lavaged, and lavage fluid analyzed for inflammation. Instillation of the LTB did not induce lung inflammation. Instillation of zymosan particles into rat and dog lungs resulted in lung inflammation and caused a significant increase in LTB levels in the lavage fluid. Pretreatment with the lipoxygenase inhibitor, nordihydroguaiaretic acid, decreased the inflammatory response and decreased LTB levels in lavage fluid. These experiments support the hypothesis that LTB is a mediator of lung inflammation. 11 references, 5 figures.

34894 (LMF—114, pp 370-373) **Antigen sensitivity in localized lung immunity.** Bice, D.E.; Muggenburg, B.A. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

The purpose of this study was to determine if immune memory is present in the lungs after multiple antigen challenges. Results indicated that challenge of previously immunized lung lobes with low, noninflammatory antigen doses stimulated a significant local production of antibody-forming cells (AFC). In contrast, no AFC were produced after challenge of a previously unimmunized lung lobe with an antigen dose that did not induce inflammation. These data support the hypothesis that memory cells are present in previously challenged lung lobes, and that these cells can be stimulated to produce a local production of AFC in the alveoli. 6 references, 3 figures.

34895 (PB—86-162468/XAB) **Acute and chronic effects of heavy metals and cyanide on Mysidopsis bahia (crustacea:mysidacea).** Lussier, S.M.; Gentile, J.H.; Walker, J. (Environmental Protection Agency, Narragansett, RI (USA). Environmental Research Lab.). 1985. 13p. (EPA/600/J—85/296). NTIS, PC A02/MF A01.

Acute and whole life-cycle toxicity tests were conducted with the estuarine mysid shrimp, Mysidopsis bahia, exposed to cyanide and selected heavy metals. Acute toxicity values (96h LC50) ranged from 3.5 micrograms/l for mercury to 3130 micrograms/l for lead, and were ranked in order of toxicity: (greatest)Hg, Cd, Cu, Cn, Ag, Sn, Ni, As, Cr, and Pb(least). The chronic toxicity values ranged from 1.2 micrograms/l for mercury to 893 micrograms/l for arsenic. Chronic values were calculated from either survival, time to first reproduction, or number of young produced. When acute toxicity data for the same chemical are compared, M. bahia is consistently among the more sensitive marine species. Lack of comparable data precludes a similar observation with chronic tests. Examination of the relative sensitivity of the chronic responses indicates that only for cadmium was survival more sensitive than reproduction.

5510 Physiological Systems

REFER ALSO TO CITATION(S) 34988

34896 (LMF—114, pp 377-381) **Pulmonary antibody-forming cell response in the guinea pig after intratracheal immunization.** Shopp, G.M.; Bice, D.E. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

Guinea pigs were immunized by an intratracheal instillation of 5 x 10^9 sheep red blood cells with or without the immunoadjuvant maleic vinyl ether-2 (MVE). At 6 days post immunization, a peak IgM antibody-forming cell response was detected in lung-associated lymph nodes (LALN), lung tissue, lavage fluid, blood, and spleen. The time course of the response in the LALN was similar to that of the response of the popliteal lymph node after foot pad immunization. The use of MVE significantly enhanced this response. 7 references, 3 figures, 1 table.

34897 (LMF—114, pp 387-390) **Alterations of pulmonary natural killer cell activity secondary to immunization of the primate lungs.** Haley, P.J.; Bice, D.E.; Muggenburg, B.A.; Hahn, F.F. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

Natural killer (NK) cell activity in the primate lungs was examined after immunization and repeated antigen challenge with sheep red blood cells (SRBC) to specific lung lobes. NK cell activity, as measured by target cell binding, was altered only in the presence of antibody-forming cells (AFC). NK cell-mediated conjugate

formation increased in immunized/challenged lung lobes, reaching peak levels at the same time as, or shortly after, the peak IgM AFC response. Elevated NK cell conjugate formation persisted longer than the AFC response, which terminated rapidly after peak NK cell response was achieved. In vitro incubation of bronchoalveolar lavage samples with poly I:poly C resulted in a rise in NK cell conjugate formation accompanied by a sharp decline in the number of AFC. These data suggested that pulmonary NK cells are involved in termination of the antibody-forming response in the lungs. 5 references, 2 figures.

34898 (LMF—114, pp 404-407) **Frequency content of forced exhalations of normal rats.** Mauderly, J.L.; Seiler, F.A. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

The frequency content of forced exhalations of healthy adult rats were analyzed by LaPlace transform. Maximal inflations and forced deflations of the lungs of apneic, anesthetized rats were induced by altering airway pressure. Amplitudes and phases of frequency components from 4 to 96 Hz were calculated for both the rats and for the test system without a rat. Males had higher amplitudes than females below 48 Hz, but phases did not differ. The majority of information useful for conventional analyses of forced exhalations is contributed by low frequencies. Of the total cumulative amplitude to 96 Hz, 50% and 95% are contributed by frequencies below 12 and 52 Hz, respectively. 5 references, 3 figures.

34899 (LMF—114, pp 408-411) **Influence of driving pressure on forced expiratory flows of dogs.** Gerlach, R.F.; Mauderly, J.L. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

Flow-volume curves were recorded during forced exhalations of four Beagle dogs, varying negative airway pressure to determine the most appropriate driving pressure for routine use. The peak flow rates of all dogs increased with increasingly negative pressures from -100 to -250 cm of H_2O. At intermediate and lower lung volumes, flows increased with driving pressure to maxima and then decreased with more negative pressures. This effect was greatest at 50% of forced vital capacity. An expiratory driving pressure of -200 cm of H_2O was selected as giving the best combination of maximum flows at all lung volumes. At this pressure, peak flows from 7.4 to 10.1 vital capacities/sec were obtained. 7 references, 1 figure, 1 table.

5520 Public Health

REFER ALSO TO CITATION(S) 34759, 34764, 34797

34900 **(PB—86-158912/XAB) Comparison of risks and costs of hazardous-waste alternatives: methods development and pilot studies. Draft report (Final).** Lawless, E.W.; Lapp, T.W.; Ferguson, T.L.; Kelso, G.L.; Ellis, H.V. (Midwest Research Inst., Kansas City, MO (USA)). 19 Nov 1984. 1083p. NTIS, PC A99/MF A01.

The report was designed to illustrate the extent to which the assessment of risks was feasible for programs under the Resource Conservation and Recovery Act (RCRA), using state-of-the-art methodologies and available data, with a focus on land disposal. The project examines whether changes in health risks could be estimated as a hazardous-waste stream is shifted from one disposal technology to another. To determine whether the methodology could be applied in realistic situations, the report includes three case studies, with four or five management options appropriate for each. The case-study wastes are mercury-contaminated brine muds from chlorine production, distillation residues from production of carbon tetrachloride, and dioxin contaminated soil. Potential sources, probabilities, and magnitudes of releases are identified, along with their movement through all environmental media to estimate potential exposures at any point. Dose-response functions for each health effect are then combined with estimates of population distribution to yield risk estimates for the most exposed individual and the total number of cases over 200 years. Uncertainty analysis is applied to the health risk estimates, using a propagation of errors approach. Costs of installing and operating each alternative also are estimated.

5530 Agriculture And Food Technology

REFER ALSO TO CITATION(S) 34734

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

5601 Radiation Effects

REFER ALSO TO CITATION(S) 34867

34901 **(AD-A—163813/9/XAB) AFRRI (Armed Forces Radiobiology Research Institute) reports, July-September 1985. Technical report.** (Armed Forces Radiobiology Research Inst., Bethesda, MD (USA)). 1985. 81p. NTIS, PC A05/MF A01.

The following titles are included in this collection of reprints: Characterization of radiation induced performance decrement using a two-lever shock-avoidance task; Fluorescence kinetics of emission from a small finite volume of a biological system; Effect of ionizing radiation on gastric secretion and gastric motility in monkeys; Radiation effects on diamine oxidase activities in intestine and plasma of the rat; Wound-induced alterations in survival of ^{60}Co irradiated mice - importance of wound timing; Quaternary naltrexone reverses morphine-induced behaviors; Electronic processes in organic solids.

34902 **(AD-A—163814/7/XAB) AFRRI (Armed Forces Radiobiology Research Institute) reports, April-June 1985. Technical report.** (Armed Forces Radiobiology Research Inst., Bethesda, MD (USA)). 1985. 84p. NTIS, PC A05/MF A01.

The following titles are included in this collection of reprints: Presence of a high-affinity Ca(s+) - and Mg(2+) - dependent ATPase in rat peritoneal mast-cell membranes; Prostanoid production by lipopolysaccharide stimulated Kupffer cells; Antihistamines block radiation-induced increased intestinal blood flow in canines; WR-2721 inhibition of radiation-induced prostaglandin excretion in rats; Effects of mixed neutron-gamma total-body irradiation on physical activity performance of rhesus monkeys; Immunologic and hematologic perturbations in models of combined injury; Hematopoiesis in conventional mice after wound trauma; Carrier generation recombination, and transport in organic crystals; Energy transfer and molecular weight effects on polymer luminescence. Keywords: Radiobiology; Military research.

34903 **(AD-A—164294/1/XAB) Stimulated hemopoiesis and enhanced survival following glucan treatment in sublethally and lethally irradiated mice.** Patchen, M.L.; MacVittie, T.J. (Armed Forces Radiobiology Research Inst., Bethesda, MD (USA)). 1985. 10p. (AFRRI-SR—85-39). NTIS, PC A02/MF A01.

Hemopoietic effects of the reticuloendothelial agent glucan were assayed in normal mice and in mice hemopoietically depleted by exposure to ^{60}Co radiation. In normal mice, glucan administration increased the content of bone marrow and splenic transplantable pluripotent hemopoietic stem cells (CFU-2), committed granulocyte-macrophage progenitor cells (GM-CFC), and pure macrophage progenitor cells (M-CFC). Erythroid progenitor cells (CFU-e) were increased only in the spleen. In sublethally irradiated mice (650 rads), glucan increased the number of endogeneous pluripotent hemopoietic stem cells (E-CFU) when administered either before or after irradiation. The most pronounced effects were observed when glucan was administered 1 day before, 1 h before, or 1 h after irradiation. In addition, the administration of glucan before lethal irradiation (900 rads) enhanced survival. The most significant results were seen when glucan was administered 1 day prior to irradiation. The possibility of using agents such as glucan to enhance hemo-

poietic reconstitution and prevent septicemia following chemotherapy and/or radiotherapy is discussed.

34904 (DOE/EV/02283—6) **Response of a forest ecotone to ionizing radiation. Final report.** Murphy, P.G.; Sharitz, R.R. (Michigan State Univ., East Lansing (USA); Savannah River Ecology Lab., Aiken, SC (USA)). May 1986. Contract AC02-76EV02283. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010943.

Compositional and structural characteristics of three forest types, including aspen dominated, maple-birch dominated, and an intervening ecotone (midecotone), were studied before and after irradiation in northern Wisconsin. The cumulative exposure resulting from 3300 hours of point-source gamma irradiation was estimated to be 55 kR at 10 m. In all three areas, the density of seedlings at 10 m was greatly reduced within a year following the 1972 radiation event. In the maple-birch area, seedlings were virtually absent at 10 m until 1982 and 1983 when their numbers were comparable to preirradiation levels, and 1984 when they were more than twice as abundant. In the aspen and midecotone areas, 1984 seedling densities at 10 m were only 42 and 17%, respectively, of the preirradiation levels. Similar but less pronounced seedling trends were observed at 20 m but not beyond that distance. Woody plants of tree stature were eliminated at 10 m in all three areas within two years of irradiation but by 1979 (maple-birch area) and 1982 (midecotone area) this size class was once again represented. By 1984 only the aspen area lacked plants at least 2.5 cm in dbh. In 1984, 12 years subsequent to irradiation, total leaf litter production was 109 and 97% of 1971 preirradiation levels at 10 m in aspen and midecotone areas, respectively. But at 10 m in the maple-birch area, it was only 58% of the preirradiation level.

34905 (KAERI/MR—78/84) **Radiological safety and control.** (Korea Advanced Energy Research Inst., Daeduk (Republic of Korea)). Mar 1985. 153p. (In Korean). NTIS (US Sales Only), PC A08/MF A01. File Number DE86780464.

Individual papers were processed for the data base.

34906 (KAERI/RR—450-1/84, pp 3-55) **Reduction of radiation effects by chemical protector (WR-2721).** Lee, C.H.; Kim, Y.K.; Yun, T.K.; Koh, J.H. (Korea Advanced Energy Research Inst., Daeduk, Republic of Korea; Cancer Research Hospital, Seoul, Republic of Korea). Apr 1985. (In Korean). NTIS (US Sales Only), PC A08/MF A01. File Number DE86780466.

In Studies on the safety assessment for environmental radiation and radioactivity (II).

As a part studies on effect of radiation, the present report was carried out to evaluate the changes of leukocytes, lymphocytes percent of leukocytes and several organs in swiss webster (NIH-GP) mice by radiation protective agents prior to γ-ray exposure. The whole body irradiation after administration of a radiation protective agents was done in dose level of 25, 50, 100 and 300 rads by a single exposure of γ-ray delivered from ^{60}Co source tele-irradiation unit at a dose rate of 100 rad/min. Mice of each experimental group were whole body γ-irradiated in plastic cage with special producted rotating machine. The radiation protective agent employed was WR-2721 and the amounts injected intraperitoneally were 400mg/kg of body weight. The leukocytes were counted with hemocytometer. Differential count of leukocytes was done with 200 cells every smear and lymphocyte percent of leukocyte were determined in relative proportion only. All major organs were examined grossly and weighted. After fixation with formalin solution, histopathological preparations were made for microscopical study.

34907 (KAERI/RR—450/1/84) **Studies on the safety assessment for environmental radiation and radioactivity (II).** (Korea Advanced Energy Research Inst., Daeduk (Republic of Korea)). Apr 1985. 156p. (In Korean). NTIS (US Sales Only), PC A08/MF A01. File Number DE86780466.

Items within the scope of EDB have been entered individually into the data base. (ACR)

34908 (LMF—114, pp 69-75) **Concepts for modeling clearance of inhaled particles deposited in the respiratory tract of people.** Cuddihy, R.G.; Yeh, H.C. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

Dosimetry models for inhaled radioactive aerosols are being developed to provide general methods for calculating radiation doses to nasal airway epithelium, bronchial epithelium, the pulmonary region of the lung and thoracic lymph nodes. The calculations are intended to apply to people of different body size, health status, and smoking habits. This report discusses only the respiratory tract clearance aspects of the dosimetry model. In contrast to dosimetry models used previously to develop exposure control guidelines for radiation workers, the model described here represents (a) clearance in nasal and bronchial airways in terms of a continuous mucus flow with competing absorption into the blood, (b) clearance in the pulmonary region using time varying mechanical transfer and absorption rate functions, and (c) thoracic lymph nodes separate from the pulmonary region with uptake and clearance rates derived from experimental studies. 25 references, 2 figures.

34909 (LMF—114, pp 106-110) **Biokinetics of inhaled curium compounds in dogs.** Guilmette, R.A. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

To study the effect of chemical form on the biokinetics of inhaled ^{244}Cm aerosols, adult Beagle dogs were exposed to aerosols of either Cm_2O_3 or $Cm(NO_3)_3$. Excreta and tissue data from radiochemical analysis were used to evaluate the temporal retention and radiation dose patterns for each group. Both Cm aerosols were rapidly cleared from the lungs and translocated mainly to liver and bone. About 30% of the initial lung burden (ILB) was in liver and 30% in bone by 30 days after exposure, while only 25% ILB remained in lungs. Over the 2-yr period of this study, the only differences in distribution and kinetics of the two forms of Cm occurred during the first 2 wk after exposure. The respective radiation doses to lung, liver, and bone were within 30% for the two aerosols of ^{244}Cm. 5 references, 3 figures, 2 tables.

34910 (LMF—114, pp 111-114) **Effect of specific activity on the dosimetry of inhaled PuO_2 aerosols.** Guilmette, R.A.; Mewhinney, J.A.; Diel, J.H. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

Studies using dogs that inhaled monodisperse aerosols of $^{238}PuO_2$ or $^{239}PuO_2$ have shown significant differences in the biokinetics of Pu and the related radiation doses received. The differences in disposition of the two Pu isotopes were attributed to the higher specific activity of $^{238}PuO_2$ compared to $^{239}PuO_2$ which led to particle fragmentation and accelerated systematic absorption. This difference resulted in higher radiation doses to liver and bone surfaces for ^{238}Pu compared to ^{239}Pu and lower doses to lungs and lymph nodes. Comparison of these dose patterns with predictions using assumptions derived from ICRP Publication 30 were made. 4 references, 3 figures, 2 tables.

34911 (LMF—114, pp 115-118) **Use of bronchopulmonary lavage as a bioassay tool for estimating Pu lung burdens.** Guilmette, R.A.; Muggenburg, B.A.; Cambron, B.L. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

Since existing methods for estimating lung burdens of inhaled actinides have limitations in their accuracy, the authors studied selective bronchoscopic lavage as a bioassay tool to estimate lung burdens of plutonium in particular. Six adult Beagles briefly inhaled a polydisperse aerosol of $^{239}PuO_2$ treated at 1150°C to achieve lung burdens of about 200 nCi. On the sixth day after exposure, each lung lobe of each dog was lavaged with 50 ml of saline. Each dog was sacrificed, and tissue samples obtained for radiochemical analysis. Using the relationship between regional deposition patterns of aerosols and the measured recoveries of Pu in each lavage sample, the lung burden of each dog was estimated. The

mean ratio for the lung burden estimates using lavage samples compared to the radiochemically determined lung burden was 1.0 +/- 0.7. 2 references, 2 figures.

34912 (LMF—114, pp 119-121) **Uptake and retention of ^{238}Pu in glandular tissue of the rat, chinese hamster, and dog.** Guilmette, R.A.; Brooks, A.L.; Menzel, C.E. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

Data obtained in a previous study with male rats suggest that the uptake of Pu by mammary tissue is highly nonuniform and its retention is prolonged. Since there is little information regarding Pu dosimetry in mammary and other glandular tissues, this study was conducted using male and female F344/N rats, Chinese hamsters, and Beagle dogs injected intravenously with ^{238}Pu-citrate. The animals were sacrificed at various times after injection, and autoradiographs were prepared on samples of the mammary glands, adrenal glands, pancreas, and liver. Preliminary data indicated that the alpha irradiation of mammary tissue was nonuniform, because the Pu was incorporated mainly in the alveolar and ductal cells. The high level of Pu labeling noted in the mammary tissue of the male rat, equal to that of liver cells, may be specific to that species and sex. 2 tables.

34913 (LMF—114, pp 122-125) **Uptake and clearance of plutonium-238 from intact liver and liver cells transplanted into fat pads of F344/N rats.** Brooks, A.L.; Guilmette, R.A.; Hahn, F.F.; Jirtle, R.L. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

An understanding of the role of liver cells and the intact liver in plutonium biokinetics is needed. Liver cells were isolated from rats, injected into fat pads of recipient rats, and allowed 21 days to form cell colonies. Rats then received a single intraperitoneal injection of 1 μCi ^{238}Pu-citrate and were serially sacrificed. Uptake, retention, and distribution of Pu in intact liver and in liver cells growing in fat pads were determined. Intact liver cells took up about twice as much ^{238}Pu as liver cells transplanted into fat pads. However, the retention kinetics of Pu were similar for both the liver cells in the fat pads and the intact liver cells when the retention was expressed as activity per cell. 4 references, 1 figure, 1 table.

34914 (LMF—114, pp 161-167) **Toxicity studies of inhaled beta-emitting radionuclides - status report.** Hahn, F.F.; McClellan, R.O.; Boecker, B.B.; Gillett, N.A.; Hobbs, C.H.; Jones, R.K.; Lundgren, D.L.; Mauderly, J.L.; Muggenburg, B.A.; Pickrell, J.A.; Scott, B.R. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

The influence of total dose and dose-rate pattern on the effects of inhaled beta-emitting radionuclides is being studied in laboratory animals. The inhaled radionuclides were either in a relatively soluble form ($^{90}SrCl_2$, $^{144}CeCl_3$, $^{91}YCl_3$, or $^{137}CsCl$), or in a relatively insoluble form, in fused alumino-silicate particles. The organs affected depend on the solubility and chemical characteristics of the radionuclides. Studies with young adult dogs are complemented by comparable studies in other species (mice, rats, and Syrian hamsters), with animals of different ages and animals repeatedly exposed to ^{144}Ce. 12 references, 2 figures, 2 tables.

34915 (LMF—114, pp 168-174) **Annual report references to dog longevity studies in which all dogs have died.** Boecker, B.B. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

Several of the life-span studies involving dogs that inhaled beta-emitting radionuclides (^{90}Sr, ^{144}Ce, ^{91}Y) have reached the point where all of the dogs have died. References to all annual report summaries for these studies are tabulated for the use of those who need further information on the significant occurrences in each of these studies and when they occurred. 4 figures, 4 table.

34916 (LMF—114, pp 175-180) **Single inhalation exposure to $^{90}SrCl_2$ in the Beagle dog: early hematological effects.** Gillett, N.; Muggenburg, B.A.; Hahn, F.F.; Boecker, B.B.; Rebar, A.H.; McClellan, R.O. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

Young adult Beagle dogs were exposed once to aerosols containing $^{90}SrCl_2$ to obtain initial body burdens ranging from 2.5 to 250 uCi ^{90}Sr/kg body weight and subsequently observed throughout their life span. All of the dogs are now dead. The primary cause of death over the entire length of the study was radiation-induced osteosarcomas. However, six dogs died at less than 30 days after exposure as a result of a radiation-induced bone marrow aplasia. Review of hematological parameters of all dogs showed a similar, consistent, and often dramatic pancytopenia in those animals having a long-term retained burden of greater than 10 uCi ^{90}Sr/kg. The hematologic changes were similar to those seen in people exposed to high doses of whole body external radiation. 4 references, 1 figure, 1 table.

34917 (LMF—114, pp 181-184) **Toxicity of injected $^{137}CsCl$ in Beagle dogs. XIX.** Muggenburg, B.A.; Hahn, F.F.; Boecker, B.B.; Jones, R.K.; McClellan, R.O.; Pickrell, J.A. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

Studies of the biological consequences of intravenous exposure to ^{137}CsCl were conducted in Beagle dogs. The 54 dogs that were injected with ^{137}CsCl and the 12 control dogs injected with stable CsCl have died. Relatively uniform chronic whole-body exposures were produced by the ^{137}Cs, and the results of that radiation pattern will be compared with the results from other diverse radiation patterns resulting from inhalation of beta-emitting radioactive aerosols. 2 references, 2 figures, 1 table.

34918 (LMF—114, pp 185-190) **Toxicity of ^{90}Y in a relatively insoluble form inhaled by Beagle dogs. XVII.** Hahn, F.F.; Hobbs, C.H.; McClellan, R.O.; Mauderly, J.L.; Pickrell, J.A. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

The metabolism, dosimetry, and biological effects of ^{90}Y inhaled in fused aluminosilicate particles are being studied in Beagle dogs. Eighty-nine dogs with initial lung burdens ranging from 80 to 5200 μCi (3.0 to 190 MBq) ^{90}Y/kg body weight and 12 control dogs are being maintained for life-span observations. The lung burdens achieved and the short effective half-life of the ^{90}Y in this chemical form resulted in a relatively high, rapidly decreasing radiation dose rate to the lung. To date, 86 exposed dogs have died - 40 from radiation pneumonitis, 9 from pulmonary neoplasms, and 37 from other causes. Eleven control dogs have died. Three exposed and one control dog still survive at 5296 to 5500 days after inhalation exposure. 3 references, 2 figures, 1 table.

34919 (LMF—114, pp 191-195) **Toxicity of ^{91}Y inhaled in a relatively insoluble form by Beagle dogs. XVI.** Hahn, F.F.; Muggenburg, B.A.; Hobbs, C.H.; McClellan, R.O. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

Beagle dogs were exposed by inhalation to aerosols of ^{91}Y in fused aluminosilicate particles, resulting in initial lung burdens ranging from 11 to 360 μCi (0.4-13 MBq) ^{91}Y/kg body weight. These 96 dogs, plus 12 controls, were maintained for life-span observation of toxic and carcinogenic effects. Dogs with the highest lung burdens died at early times with radiation pneumonitis. At later times, tumors were seen in lungs, nasal cavity, heart, and tracheobronchial lymph nodes; these organs received the highest radiation doses. Observations are continuing on the 5 exposed and 3 control dogs that remain alive 5120 to 5605 days after exposure. 2 figures, 1 table.

34920 (LMF—114, pp 196-201) **Toxicity of ^{144}Ce inhaled in a relatively insoluble form by Beagle dogs. XVIII.** Boecker, B.B.; Hahn, F.F.; Muggenburg, B.A.; Gillett, N.A.; Mauderly, J.L.; McClellan, R.O.; Pickrell, J.A. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

The long-term biological consequences of inhaling graded activity levels of an insoluble form of ^{144}Ce are being studied in life-span studies of Beagle dogs. One hundred and eleven young adult dogs received single, brief inhalation exposures of ^{144}Ce in fused aluminosilicate particles that resulted in initial lung burdens ranging from 0.0024 to 210 μCi/kg body weight (0.089 to 7800 kBq/kg), and 15 others inhaled nonradioactive fused aluminosilicate particles. At the present time (at least 14 yr after exposure), 102 ^{144}Ce-exposed and 14 control dogs have died or been euthanized. Observations are continuing on the remaining 9 ^{144}Ce-exposed and 1 control dogs. 3 references, 3 figures, 1 table.

34921 (LMF—114, pp 202-206) **Toxicity of ^{144}Ce inhaled in a relatively insoluble form by immature Beagle dogs. XIV.** Boecker, B.B.; Muggenburg, B.A.; Hahn, F.F.; Mauderly, J.L.; McClellan, R.O. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

To study the long-term biological effects of an inhaled beta emitter in a relatively insoluble form, immature Beagle dogs (3 mo old) received a single brief inhalation exposure to ^{144}Ce in fused aluminosilicate particles. This study involves 54 dogs, 49 of which received initial lung burdens of ^{144}Ce ranging from 0.004 to 140 μCi/kg (0.15 to 5200 kBq/kg) body weight, and 5 that inhaled nonradioactive fused aluminosilicate particles. At the present time, 21 ^{144}Ce-exposed and 2 control dogs are alive and observations on them are continuing. Early death (during the first 4 mo) were related to radiation pneumonitis, pulmonary fibrosis, and congestive heart failure. Later deaths have involved both pulmonary and extrapulmonary hemangiosarcomas. During the past year, 2 dogs died of pulmonary carcinomas. 2 figures, 1 table.

34922 (LMF—114, pp 207-211) **Toxicity of ^{90}Sr inhaled in a relatively insoluble form by Beagle dogs. XVI.** Snipes, M.B.; Hahn, F.F.; Muggenburg, B.A.; Mauderly, J.L.; McClellan, R.O.; Pickrell, J.A. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

This study was initiated to determine health effects resulting from inhalation of ^{90}Sr in a relatively insoluble form. Beagle dogs were briefly exposed by inhalation to produce lung burdens of ^{90}Sr that ranged from 0.12 to 96 μCi (4.4 to 3550 kBq) per kilogram body weight. High-level exposures caused radiation pneumonitis and pulmonary fibrosis, resulting in deaths, typically less than 500 days after exposure. Lower-level exposures are producing long-term health effects, including cancer of the lungs heart, and tracheobronchial lymph nodes. Most tumors have been hemangiosarcomas. Four control dogs and three ^{90}Sr-exposed dogs died or were euthanized during the past year. The remaining 12 exposed and 5 control dogs are being maintained for lifetime observation; they range from 11 to 15 yr old. 2 figures, 2 table.

34923 (LMF—114, pp 212-215) **Biological effects of repeated inhalation exposure of Beagle dogs to relatively insoluble aerosols of ^{144}Ce. XI.** Boecker, B.B.; Hahn, F.F.; Muggenburg, B.A.; McClellan, R.O.; Mauderly, J.L.; Pickrell, J.A. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

To study the biological effects of repeated inhalation exposures to a beta emitter compared to those seen after a single inhalation exposure, Beagle dogs were exposed in different regimens to a relatively insoluble form of ^{144}Ce, in a fused aluminosilicate matrix. Four groups of 9 dogs each were exposed once every 8 wk for 2 yr (13 exposures). The exposures were conducted (1) to increase the lung burden by 2.5 (93 kBq) ^{144}Ce/kg body weight with each exposure, (2) to re-establish lung burdens of 9.0 or 4.5 μCi (330 or 170 kBq) ^{144}Ce/kg body weight, and (3) to expose controls to fused aluminosilicate particles containing nonradioactive Ce. The most prevalent findings have been pulmonary carcinomas (10 dogs) and hemangiosarcomas in the tracheobronchial lymph nodes (5 dogs). All ^{144}Ce-exposed dogs are now dead; observations are continuing on the 4 remaining control dogs at 11.8 yr after the first exposure. 2 tables.

34924 (LMF—114, pp 216-219) **Effects of relatively low-level exposure of rats to inhaled $^{144}CeO_2$. I.** Lundgren, D.L.; Hahn, F.F.; Griffith, W.C.; Cuddihy, R.G.; Boecker, B.B. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

A study was initiated to provide data on the risk of lung cancer in rats exposed to relatively low doses from an inhaled beta-emitting radionuclide, ^{144}Ce. These data will be used in a matrix of inter-species data to estimate the risk of lung cancer in people exposed by inhalation to a beta-emitting radionuclide. All rats in this study have been exposed. The initial lung burdens achieved and the associated total lung doses of about 350, 1200, and 4000 rad (3.5, 12, and 40 Gy) meet experimental design parameters. 5 references, 1 figure, 1 table.

34925 (LMF—114, pp 220-225) **Toxicity of inhaled alpha-emitting radionuclides - status report.** Muggenburg, B.A.; Mewhinney, J.A.; Guilmette, R.A.; Lundgren, D.L.; Hahn, F.F.; Boecker, B.B. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

The toxicity of inhaled alpha-emitting radionuclides is being investigated in a series of interrelated dose-response studies. Dogs, rodents, and nonhuman primates are being exposed to monodisperse and polydisperse aerosols of the oxides of ^{239}Pu, ^{238}Pu, ^{241}Am, and ^{244}Cm to measure the relative importance of average organ dose, local dose around particles, specific activity, chemical form, particle size, and number of particles inhaled to the development of biological effects. The influence of animal species, age at exposure, and pre-existing lung disease are also being studied because they may influence the toxicity of these radionuclides. 6 references, 3 figures, 1 table.

34926 (LMF—114, pp 226-235) **Toxicity of inhaled $^{238}PuO_2$ in Beagle dogs. A. Monodisperse 1.5 μm AMAD particles. B. Monodisperse 3.0 μm particles. XII.** Mewhinney, J.A.; Hahn, F.F.; Muggenburg, B.A.; Gillett, N.A.; Diel, J.H.; Mauderly, J.L.; Boecker, B.B.; McClellan, R.O. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

Beagle dogs inhaled one of two sizes of monodisperse aerosols of $^{238}PuO_2$ that resulted in graded activity levels of ^{238}Pu in the lung. All dogs are being studied for their life span. One hundred and twelve dogs that had initial lung burdens ranging from 0.01 to 1.5 μCi ^{238}Pu per kilogram body weight (0.37 to 56 kBq/kg) have died, 8 with radiation pneumonitis and pulmonary fibrosis, 4 with lung tumors, 79 with bone tumors, 3 with liver tumors, and 18 of miscellaneous causes. Five control dogs have died. Observations are being continued on 32 exposed and 19 control dogs alive at 3482-4310 days after exposure. 2 references, 8 figures, 1 table.

34927 (LMF—114, pp 236-243) **Toxicity of inhaled $^{239}PuO_2$ in Beagle dogs. A. Monodisperse 0.75-μm AMAD particles. B. Monodisperse 1.5-μm AMAD particles. C. Monodisperse 3.0-μm AMAD particles. VIII.** Muggenburg, B.A.; Guilmette, R.A.; Hahn, F.F.; Boecker, B.B.; McClellan, R.O. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

Beagle dogs were exposed to monodisperse aerosols of $^{239}PuO_2$ of 0.75-, 1.5-, or 3.0-μm activity median aerodynamic diameter (AMAD) to obtain information on the relative importance

of homogeneity of alpha irradiation doses to the lung. The dogs' graded initial lung burdens ranged from 0.0002 to 2.6 μCi (0.0074 to 96 kBq) ^{239}Pu/kg of body weight. Thirty-six dogs exposed to the aerosol diluent are the controls. Twenty-four exposed dogs have died to date in the study with 0.75-μm AMAD particles, 57 in the study with 1.5-μm AMAD particles, and 50 in the study with the 3.0-μm AMAD particles. Three control dogs have died. The dogs exposed to ^{239}Pu that have died to date have died with radiation pneumonitis and fibrosis and/or lung cancer. Surviving dogs have lived up to 3100 days after exposure. 6 figures, 1 table.

34928 (LMF—114, pp 244-248) **Toxicity of inhaled $^{239}PuO_2$ in immature Beagle dogs. VII.** Guilmette, R.A.; Muggenburg, B.A.; Hahn, F.F.; Mauderly, J.L.; Boecker, B.B.; McClellan, R.O. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

Immature Beagle dogs have been exposed by inhalation to a monodisperse aerosol of $^{239}PuO_2$ (1.5 μm AMAD) to compare the biological effects with those observed in dogs exposed to a similar aerosol as young or aged adults. The study includes 96 dogs exposed to $^{239}PuO_2$ and 12 controls. The lung burdens of the plutonium-exposed dogs ranged from 0.00030 to 0.80 μCi/kg body weight (0.011-30 kBq/kg). No dogs died during this year. Seven dogs were diagnosed as having developing lung disease, mainly fibrosis, and one had a developing lung tumor. With 20 dogs having estimated cumulative radiation doses in excess of 1000 rad (10 Gy), the biological response of the dogs exposed as juveniles appears to be less than that seen in mature dogs. However, major uncertainties still exist in the current estimations of radiation dose, particularly regarding the local distribution of alpha radiation dose. 1 reference, 4 figures, 1 table.

34929 (LMF—114, pp 249-253) **Toxicity of $^{239}PuO_2$ inhaled by aged Beagle dogs. VII.** Muggenburg, B.A.; Hahn, F.F.; Gillett, N.A.; Guilmette, R.A.; Boecker, B.B.; McClellan, R.O. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

The effects of age at exposure on the metabolism, dosimetry, and biological effects of inhaled particles of $^{239}PuO_2$ are being studied in aged Beagle dogs (8.0 to 10.5 yr of age at exposure). Forty-eight dogs inhaled $^{239}PuO_2$ particles with an activity median aerodynamic diameter of 1.5 μm to achieve initial lung burdens ranging from 0.02 to 0.66 μCi ^{239}Pu/kg body weight (0.75 to 24 kBq/kg). Twelve other dogs were exposed to the aerosol diluent only. Forty-three exposed dogs have died, including four in the past year, and eight control dogs have died, including four in the past year. Radiation pneumonitis and fibrosis have been the primary causes of death in these aged dogs exposed to $^{239}PuO_2$. 1 reference, 2 figures, 1 table.

34930 (LMF—114, pp 254-258) **Repeated inhalation exposure of Beagle dogs to aerosols of $^{239}PuO_2$. IX.** Diel, J.H.; Hahn, F.F.; Muggenburg, B.A. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

Beagle dogs were exposed once or repeatedly by inhalation to aerosols of $^{239}PuO_2$ to study the relative doses and effects of these two types of exposures. Dogs exposed repeatedly by inhalation to $^{239}PuO_2$ at levels high enough to cause fatal pulmonary fibrosis exhibit the same effect at the same cumulative dose as those exposed only once. Experiments described here in which dogs inhaled lower levels of $^{239}PuO_2$ have not progressed far enough to determine the relative tumorigenic effects of single and repeated exposures. 2 references, 3 figures, 1 table.

34931 (LMF—114, pp 259-264) **Repeated inhalation exposure of mice to aerosols of $^{239}PuO_2$. IV.** Lundgren, D.L.; Gillett, N.A.; Hahn, F.F.; McClellan, R.O. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

To determine the long-term biological effects of protracted alpha radiation dose to lungs, mice were repeatedly exposed by inhalation at bimonthly intervals for one year to aerosols of $^{239}PuO_2$ to reestablish lung burdens of 0.5, 2.5, or 12.5 nCi (18, 92, or 460 Bq). Other mice were exposed once to achieve desired initial lung burdens of 0.5, 2.5, 12.5, or 62.5 nCi (18, 92, 460, or 2300 Bq). Control mice were sham exposed once or repeatedly to aerosols of stable Yb_2O_3 or $^{169}Yb_2O_3$. Groups with similar cumulative radiation doses to the lungs had a greater incidence of lung tumors when alpha irradiation to the lungs was protracted by the repeated exposures compared to that received with a single exposure when there was minimal life-shortening. 8 references, 1 figure, 2 table.

34932 (LMF—114, pp 265-269) **Influence of heterogeneous alpha irradiation of Chinese hamster liver on the induction of cancer and chromosome abnormalities.** Guilmette, R.A.; Brooks, A.L.; Gillett, N.A.; Hahn, F.F.; Eidson, A.F. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

Chinese hamsters were intravenously injected with colloidal thorium dioxide (Thorotrast) or ^{239}Pu citrate. This is a status report on the induction of chromosome aberrations and early observations on the induction of cancer in these animals. The frequency of chromosome aberrations increased as a function of radiation dose with a slope of 0.53 aberrations/cell/gray which was similar to 0.48 aberrations/cell/gray observed for ^{239}Pu citrate. Twenty of twenty-five hamsters injected with the highest activity level of Thorotrast that died between 162 and 428 days after injection had fibrosarcomas or osteosarcomas at the site of the injection. 4 references, 3 figures, 2 tables.

34933 (LMF—114, pp 270-274) **Origin of pulmonary tumors after inhalation of insoluble beta-emitting radionuclides.** Hahn, F.F.; Boecker, B.B.; Snipes, M.B.; Muggenburg, B.A. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

Life span studies of Beagle dogs that inhaled beta-emitting radionuclides in a relatively insoluble form (^{90}Y, ^{91}Y, ^{144}Ce, ^{90}Sr) were designed to determine the types and locations of radiation-induced tumors and the influence of dose protraction on tumor incidence. Although these studies are not complete, data on lung tumor types presently available were used for this analysis. Lung tumor types indicate that numerous cell types are at risk after inhalation of beta-emitting radionuclides. Tumors of blood vessels, connective tissue, and pulmonary epithelium have been seen. The numerous cell types involved make it difficult to designate one cell type at risk. The tumors originated in the alveolar portions of the lung, not the larger airways. 2 references, 1 figure, 2 tables.

34934 (LMF—114, pp 275-279) **Logistic regression analysis of dose-effect information obtained from studies of Beagles that inhaled $^{90}SrCl_2$.** Griffith, W.C. Jr.; Gillett, N.A.; McClellan, R.O.; Muggenburg, B.A.; Hahn, F.F.; Boecker, B.B.; Jones, R.K.; Cuddihy, R.G. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

An analysis of bone tumor incidence in Beagle dogs exposed to $^{90}SrCl_2$ using logistic regression indicates that the logit of the probability of bone-related neoplasms is described adequately as a linear function of bone dose to death. The bone tumor incidence appears to rise sharply above 5000 rad (50 Gy). When measures of dose rate were added to the dose-response relationship, they were not found to improve the relationship significantly. There were no important differences between male and female dogs in their dose-response relationships. 1 reference, 1 figure, 2 tables.

34935 (LMF—114, pp 344-347) **Biokinetics of $^{239}PuO_2$ inhaled by aged dogs.** Guilmette, R.A.; Muggenburg, B.A.; Boecker, B.B. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

To study the effect of age at exposure on the dosimetry and biological effects of inhaled $^{239}PuO_2$, eight to ten year old Beagle dogs were exposed to a monodisperse aerosol of $^{239}PuO_2$ treated at 1150°C. This report describes the biokinetics of ^{239}Pu in 26 dogs that died between 129 and 1105 days after exposure, primarily from radiation pneumonitis and pulmonary fibrosis. Radioassay of ^{239}Pu in different organs and tissues provided data for determining the retention kinetics in each tissue. These functions were then used to calculate cumulative radiation doses to the tissues at risk. Comparison of these doses with analogous doses for dogs exposed as young adults shows that the doses for the two populations differ by less than a factor of two, except for hepatic lymph nodes. 1 reference, 1 figure, 2 tables.

34936 (LMF—114, pp 348-353) **Comparison of retention of ^{241}Am in immature, young adult, and aged dogs and in monkeys after inhalation of $^{241}AmO_2$.** Mewhinney, J.A.; Muggenburg, B.A. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

To determine the potential influence of age at time of inhalation exposure upon lung retention, tissue distribution, and excretion of ^{241}Am, groups of Beagle dogs received a single inhalation exposure to polydisperse aerosols of $^{241}AmO_2$. The three age groupings were immature (90 days of age at exposure), young adult (12 to 14 months of age at exposure), and aged (6 to 10 years of age at exposure). In a companion study, adult cynomolgus monkeys were exposed to the same aerosol to provide information of the potential influence of species upon lung retention, tissue distribution, and excretion. Results of these studies indicated that age at exposure influenced deposition of ^{241}Am dissolved in lungs and transported to the liver and skeleton. Differences in retention and distribution of ^{241}Am in monkeys was different than measured in dogs. 5 references, 3 figures, 3 tables.

34937 (LMF—114, pp 364-369) **Effects of bone marrow depression on the development of bleomycin-induced pulmonary fibrosis.** Pino, M.V.; Pickrell, J.A.; Hahn, P.F. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

The effects of blood leukocyte depression on the development of bleomycin-induced pulmonary fibrosis were studied in F344/N rats injected with ^{89}Sr to destroy bone marrow cells. The ^{89}Sr injections were followed in 7 days by intratracheal instillation of bleomycin. At 3 to 30 days after bleomycin, the lung injury in rats given both ^{89}Sr and bleomycin was compared to animals given bleomycin alone. The ^{89}Sr treated rats had reduced numbers of circulating granulocytes, a less severe pulmonary inflammatory response, and a delayed, but not abrogated, pulmonary fibrosis compared to animals given bleomycin alone. 4 references, 4 figures, 2 tables.

34938 (PB—86-158573/XAB) **Induction of DNA-protein crosslinks in human cells by ultraviolet and visible radiations: action spectrum.** Peak, J.G.; Peak, M.J.; Sikorski, R.S.; Jones, C.A. (Argonne National Lab., IL (USA)). 1985. 10p. NTIS, PC A02/MF A01.

DNA-protein crosslinking was induced in cultured human P3 teratocarcinoma cells by irradiation with monochromatic radiation with wavelengths in the range 254-434 nm (far-UV, near-UV, and blue light). Wavelength 545 nm green light did not induce these crosslinks, using the method of alkaline elution of the DNA from membrane filters. The action spectrum for the formation of DNA-protein crosslinks revealed two maxima, one in the far-UV spectrum that closely coincided with the relative spectrum of DNA at 254 and 290 nm, and one in the visible light spectrum at 405 nm, which has no counterpart in the DNA spectrum. The primary events for the formation of DNA-protein crosslinks by such long-wavelength radiation probably involve photosensitizers. This dual mechanism for DNA-protein crosslink formation is in strong contrast to the single mechanism for pyrimidine dimer formation in DNA, which apparently has no component in the visible light spectrum.

34939 (PB—86-935500/XAB) **Radiation carcinogenesis. Cancergram CK06.** (National Cancer Inst., Bethesda, MD (USA). International Cancer Research Data Bank). 1986. vp. NTIS.

Subscription.

The Cancergram deals with all aspects of radiation carcinogenesis. The term radiation here includes uv radiation and the entire electromagnetic spectrum, electron and other charged-particle beams, neutrons, and alpha and beta radiation from radioactive substances. Abstracts included concern relationships between radiation and carcinogenesis in humans, experimental induction of tumors in animals by irradiation, studies on the mechanism of radiation carcinogenesis at the cellular level, studies of RBE, dose response or dose threshold in relation to radiation carcinogenesis, and methods and policies for control of radiation exposure in the general population. In general, this Cancergram excludes abstracts on radiotherapy, radiologic diagnosis, radiation pathology, and radiation biology, where these articles have no bearing on radiation carcinogenesis.

34940 (PNL-SA—12650) **Impact of upgraded in vivo lung measurement capability on an internal dosimetry program.** Carbaugh, E.H.; Sula, M.J.; Aldridge, T.L.; Spitz, H.B. (Pacific Northwest Labs., Richland, WA (USA)). Aug 1985. Contract AC06-76RL01830. 11p. (CONF-8509212—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010939.

From 2. international workshop on lung dosimetry; Cambridge, England (2 Sep 1985).

Implementation of high-purity germanium (Ge) detectors in place of sodium iodide (NaI) detectors for in vivo lung measurements of low-energy photon-emitting radionuclides resulted in significant improvement in detection capability and corresponding improvements in the monitoring of potentially exposed workers. Lung activities below those detectable with the NaI system were discovered during the first 18 months of operation. In a number of cases, these activities were estimated to represent intakes resulting in lung doses as high as 25% of the 15 rem/y United States Department of Energy Radiation Protection Standard. Evaluation of these lung activities and their associated intakes was substantially more time consuming than originally anticipated due to calibration differences between the Ge and NaI systems and to the difficulty of completing some of the follow-up investigations.

34941 **Extracorporeal irradiation of blood: dosimetry corrected for shortened erythrocyte lifespans.** Slatkin, D.N.; Pate, H.R.; Cronkite, E.P. (Brookhaven National Lab., Upton, NY). *Experimental Hematology;* No. 1, 75-79(Jan 1986).

The amount of radiation delivered to erythrocytes during extracorporeal irradiation of blood (ECIB) has been described using Poisson distribution statistics. The Poisson expression for erythrocyte radiation dose distribution was simplified by considering the slight dilution of blood with fluid that is initially in the extracorporeal tubing. An algorithm was devised that allows curtailed lifespans of irradiated erythrocytes to be taken into account in a short computer program of radiation dosimetry for ECIB. Radiation doses to erythrocytes with and without lifespan corrections are compared.

34942 **Thyroid cancer risk in the population around the Nevada Test Site.** Zeighami, E.A.; Morris, M.D. (Oak Ridge National Lab., TN). *Health Physics;* No. 1, 19-32(Jan 1986).

Potential thyroid cancer risk in Utah populations due to weapons testing fallout has been examined in two ways. Thyroid cancer incidence rates for Utah for the years 1973-77 were compared to those of the reporting areas of the Surveillance, Epidemiology and End Results Registry. In addition, numbers of lifetime thyroid cancer cases and distribution of probability of causation values for those cases have been estimated for a population of about 23,000 who were in the fallout area of three major shots at the Nevada Test Site during the 1950s. A computer program designed to estimate numbers of expected and excess cases occurring in the remaining lifetime after exposure was used to make the estimates. The estimates of internal dose distribution within various age at exposure groups were made using dose estimates developed by the

Off-Site Radiation Exposure Review Project. The potential human risk from 131I at low doses is far from certain. The upper bound risk must be considered to be near that for low doses of acutely delivered external radiation to the thyroid. A practical upper limit for risk from low-dose 131I was taken to be one per million per rad-yr for males and four per million per rad-yr for females (although absolute upper limits would need to be higher). The upper bound estimate of excess cases in the lifetime of the population is about 13, compared to an estimate of about 58 cases expected to occur in the population on the basis of ordinary incidence. If excess risk is assumed to increase linearly with dose, and not to change with age, 12 of 13 excess cases fall into the group aged 18 and below at the time the dose occurred, and 11 of 13 excess cases fall into the group exposed to 10 rad or more.

34943 **A conversational Eigenanalysis program for solving differential equations.** Killough, G.G.; Eckerman, K.F. (Health and Safety Research Div., Oak Ridge National Lab., Oak Ridge, TN 37830). pp 4049-4058 of Computer applications in health physics. Kathren, R.L.; Higby, D.P.; McKinney, M.A. Richland, WA; Health Physics Society (1984). (CONF-840202—).

From 17. midyear topical meeting of the Health Physics Society; Pasco, WA, USA (5 Feb 1984).

Dynamic models that arise in health physics applications are often expressed in terms of systems of ordinary differential equations. In many cases, such as box models that describe material exchange among reservoirs, the differential equations are linear with constant coefficients, and the analysis can be reduced to the examination of solutions of initial-value problems for such systems. This paper describes a conversational code, DIFSOL, that permits the user to specify the coefficient matrix and an initial vector of the system; DIFSOL prints out closed-form solutions [i.e., expressed as linear combinations of terms of the form e⁻/sup at/, e⁻/sup at/cos bt, and e⁻/sup at/sin bt] and tables of the solution, its derivative, and its integral for any specified linear combination of state variables. The program logic permits menu-driven control. The authors have operated a FORTRAN IV version of the code on a DEC PDP-10 for several years. A translation into BASIC has proved practical on Radio Shack TRS-80 Model I and III personal computers for smaller systems of differential equations (<12 state variables). The paper includes illustrations of the use of DIFSOL in studying metabolic models.

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REFER ALSO TO CITATION(S) 33554, 33554, 33554, 33652, 33655, 33655, 33656, 33656, 33688, 33689, 33690, 33741, 34388, 34389, 34808, 34835, 34842, 34842, 34853, 34893

34944 **(CONF-8307124—Absts.) Genetic control of environmental pollutants.** (Washington Univ., Seattle (USA). Dept. of Environmental Health). 1983. Contract FG06-83ER60146. 50p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86010572.

From Conference on genetic control of environmental pollutants; Seattle, WA, USA (31 Jul 1983).

This research conference assessed strategies for more effectively and safety managing wastes and toxic substances in the environment, in part through use of genetic engineering of microorganisms.

34945 (DOE/ER—0238, pp 3-10) **Background on the response of vegetation to atmospheric carbon dioxide enrichment.** Strain, B.R. (Duke Univ., Durham, NC). Dec 1985. NTIS, PC A14/MF A01. File Number DE86007397.

In Direct effects of increasing carbon dioxide on vegetation.

A justification for the volume (Direct Effects of Increasing Carbon Dioxide on Vegetation) is presented. The relationship of the volume to others in the series is discussed. Among the components of that discussion are: projecting the climatic effects of increasing carbon dioxide; detecting the climatic effects of increasing carbon dioxide; atmospheric carbon dioxide and the global carbon cycle; direct effects of increasing carbon dioxide on vegetation; and characteristics of prerequisites for quantitative research on the indirect effects of carbon dioxide. The organization of the volume is also discussed. 62 references, 2 tables.

34946 (DOE/ER—0238, pp 11-31) **Methods of exposing plants to elevated carbon dioxide.** Drake, B.G.; Rogers, H.H.; Allen, L.H. Jr. (Smithsonian Environmental Research Center, Washington, DC). Dec 1985. NTIS, PC A14/MF A01. File Number DE86007397.

In Direct effects of increasing carbon dioxide on vegetation.

Carbon dioxide monitoring and control systems are discussed. Leaf chamber design and operation are also discussed. Controlled environments are reviewed, including phytotrons, portable growth chambers, and sunlit controlled environment chambers. Greenhouses and field tracking chambers are also discussed. Finally, open top and open field release experimental conditions are discussed. 89 references, 6 figures, 2 tables.

34947 (DOE/ER—0238, pp 34-51) **Modeling approaches for evaluating vegetation responses to carbon dioxide concentration.** Reynolds, J.F. (New Mexico State Univ., Las Cruces). Dec 1985. NTIS, PC A14/MF A01. File Number DE86007397.

In Direct effects of increasing carbon dioxide on vegetation.

The importance of modeling in assessing the effects of carbon dioxide on vegetation is discussed, and a generalized growth model is presented. Model evaluation criteria are presented and discussed; among them are: hierarchical classification, utility of various types of models, model validation, and cost classification. Model evaluation techniques are also discussed. As part of this discussion, currently available models of plant responses to CO_2 are discussed, a survey of some existing plant growth models is presented, and model uncertainty is discussed. 104 references, 7 figures, 4 tables.

34948 (DOE/ER—0238, pp 54-97) **Crop responses to elevated carbon dioxide concentrations.** Acock, B.; Allen, L.H. Jr. (Mississippi State Univ., Mississippi State). Dec 1985. NTIS, PC A14/MF A01. File Number DE86007397.

In Direct effects of increasing carbon dioxide on vegetation.

Photosynthesis, transpiration, and water-use efficiency are discussed. As part of this discussion, leaf-level responses, crop and canopy level responses, and relationships between leaf and crop responses are treated. Carbon and dry matter partitioning, the initiation, growth, and abscission or organs, and yield are also discussed. The interactions between CO_2 and other environmental factors are outlined. Several different modeling approaches are used to predict the growth and yield of crops in a future high-CO_2 world. 175 references, 11 figures, 11 tables.

34949 (DOE/ER—0238, pp 100-116) **Carbon dioxide doubling responses: a crop survey.** Cure, J.D. (Duke Univ., Durham, NC). Dec 1985. NTIS, PC A14/MF A01. File Number DE86007397.

In Direct effects of increasing carbon dioxide on vegetation.

The crop CO_2-doubling response survey is discussed; the data tables and the doubling response tables are presented as part of that discussion. Methods used to carry out the survey are described in detail. The overall CO_2-doubling responses are described, along with the interaction responses. 41 references, 1 figure, 7 tables.

34950 (DOE/ER—0238, pp 118-154) **Native species responses to increased atmospheric carbon dioxide concentration.** Oechel, W.C.; Strain, B.R. (San Diego State Univ., CA). Dec 1985. NTIS, PC A14/MF A01. File Number DE86007397.

In Direct effects of increasing carbon dioxide on vegetation.

In a discussion of photosynthesis, short-term responses of photosynthesis to elevated CO_2, long-term effects and acclimation, time courses of CO_2 response, species and growth form-dependent responses and nutrient controls on CO_2 responses are discussed. Respiration, water use and growth rates are also discussed. Exudation of carbohydrates from roots and other organs, growth and productivity, phenology and senescence, and tissue quality and chemical composition are treated in separate sections. Ecosystem effects, including nutrient availability, productivity, carbon sequestering, nutrient sequestering and interactions, system water effects and interactions, and plant-animal interactions are discussed, along with modeling efforts as they have been applied to photosynthesis, plant growth, populations, and ecosystem responses. Verification studies

of data bases, model structure, and model output are presented. 138 references, 21 figures, 6 tables.

34951 (DOE/ER—0238, pp 156-170) **Effect of increased atmospheric carbon dioxide concentration on plant communities.** Bazzaz, F.A.; Garbutt, K.; Williams, W.E. (Harvard Univ., Cambridge, MA). Dec 1985. NTIS, PC A14/MF A01. File Number DE86007397.

In Direct effects of increasing carbon dioxide on vegetation.

The studies of communities were carried out in two separate modes. Individual species experiments are described. Multispecies competition experiments were carried out and are described. Based on the experiments performed, recommendations for modeling studies are made, and recommendations for experimental approach in future studies are presented. 28 references, 9 figures, 11 tables.

34952 (DOE/ER—0238, pp 186-204) **Adaptation of vegetation and management practices to a higher carbon dioxide world.** Kimball, B.A. (Dept. of Agriculture, Washington, DC). Dec 1985. NTIS, PC A14/MF A01. File Number DE86007397.

In Direct effects of increasing carbon dioxide on vegetation.

The known responses of individual plants to higher levels of CO_2 are reviewed. The adaptation of agriculture to higher levels of CO_2 is discussed; plant selection and breeding, changes in cultural practices, and plant water relations and interactions with CO_2-induced climate change are the main topics discussed as part of the treatment. The adaptation of forestry to the changed atmospheric scenarios is discussed, along with the adaptation of the unmanaged terrestrial biosphere. 69 references, 1 table.

34953 (DOE/ER—0238, pp 207-213) **Status of knowledge and recommendations for future work.** Strain, B.R.; Cure, J.D. (Duke Univ., Durham, NC). Dec 1985. NTIS, PC A14/MF A01. File Number DE86007397.

In Direct effects of increasing carbon dioxide on vegetation.

A concise overview of the current understanding of the effects of CO_2 on plants, on communities of plants, and on ecosystems is presented. Plant-level responses, interactions with other environmental factors, and ecosystem-level observations are discussed separately. Research needs and some recommended research projects are presented.

34954 (EPRI-CS—4390-Vol.1, pp 1.1-1.19) **Comparison of regional declines of forests in Europe and North America: the possible role of airborne chemicals.** Cowling, E.B. (North Carolina State Univ., Raleigh). Jan 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920169. (CONF-850630—Vol.1).

From 9. symposium on flue gas desulfurization; Cincinnati, OH, USA (4 Jun 1985).

Human activities of many sorts have been changing the chemical climate of Europe and North America especially since the time of the Industrial Revolution. Regional declines of forests also have been occurring in Europe for the past 200 years and in North America for at least the past century. A total of 18 regional declines of forests have been reported on the two continents. These declines are generally believed to be caused by a specific combination of competitional, physical, biological, and chemical stress factors acting simultaneously or sequentially. Airborne chemicals have been implicated as an important causal factor in only four of these 18 cases. A consensus of informed judgment regarding the possible role of selected airborne chemicals is described. This judgment suggests that ozone and biologically available nitrogen compounds are among the chemical stress factors of greatest probable importance to forests. Other chemical stress factors that may also be involved include toxic gases other than ozone, toxic metals, acids, acidifying substances, and growth-altering organic chemicals. Certain implications of this present consensus are discussed briefly with regard to management of air quality in Europe and North America. 48 references, 1 table.

34955 (FWS/OBS—80(40.21), pp 30-41) **Fish community interactions, biogeographic factors and lake acidification.** Rahel, F.J. (Ohio State Univ., Columbus). Oct 1985. NTIS, PC A06/MF A01. File Number TI86900511. (CONF-8408184—Pt.1).

From 114. annual meeting of the American Fisheries Society; Ithaca, NY, USA (12 Aug 1984).

A comparison of two groups of Wisconsin lakes that differ in their sensitivity to acidification revealed significant differences in fish community composition. Small, low-alkalinity lakes that are highly vulnerable to acid inputs lack many fish (including darters, walleye, sculpin and most cyprinids) that are common in nearby lakes which are less vulnerable to acidification because of higher alkalinity. None of these lakes had been culturally acidified and thus, these patterns reflect the influence of biogeographic factors (small size, low productivity, lack of inlet/outlet streams) and biotic interactions in structuring lake fish communities. Small seepage lakes forming a lake successional gradient contained one of three distinct fish assemblages depending upon lake size, habitat heterogeneity, pH and winter oxygen concentrations. These environmental factors were good indicators of the type of fish community likely to be present. Studies such as these can be used to predict fish community composition in unsampled lakes or for earlier time periods (e.g., prior to acidification). Species-area relationships, used to estimate how many fish populations have gone extinct in acidified lakes, may overestimate the number of extinctions if regression equations developed from unacidified lakes (which have high alkalinity) are used to predict the number of fish species which should be present in acidified lakes (which had low alkalinity).

34956 (FWS/OBS—80(40.21), pp 42-48) **Early life stage brook trout (Salvelinus fontinalis) experiment to determine the effects of pH, calcium, and aluminum in low conductivity water.** Ingersoll, C.G.; La Point, T.W.; Bergman, H.L.; Breck, J. (Univ. of Wyoming, Laramie). Oct 1985. NTIS, PC A06/MF A01. File Number TI86900511. (CONF-8408184—Pt.1).

From 114. annual meeting of the American Fisheries Society; Ithaca, NY, USA (12 Aug 1984).

Brook trout eggs were exposed to varying levels of pH, calcium, and aluminum totaling 64 different combinations. The levels of pH, aluminum, and calcium were chosen to represent the chemistry of sensitive lakes and streams in eastern Canada, the northeastern US, and Scandinavia. As aluminum and acidity increased, the frequency at which embryos failed to escape from the chorion during hatching also increased, usually resulting in the death of the embryo. The effects of aluminum and low pH become evident during the hatching process and continue through yolk absorption, while the protective effects of calcium are not noted until after hatching.

34957 (FWS/OBS—80(40.21), pp 62-81) **Causes and mechanisms of fishery decline.** Howells, G. (Central Electricity Generating Board, Surrey, England). Oct 1985. NTIS, PC A06/MF A01. File Number TI86900511. (CONF-8408184—Pt.1).

From 114. annual meeting of the American Fisheries Society; Ithaca, NY, USA (12 Aug 1984).

Waters of approximately pH 5 or below may be acutely toxic to young fish if calcium is below a threshold concentration of 1 ppm. Aluminum is also toxic at low concentration when pH is around 5 to 5.5. Over the longer term, however, older fish can tolerate and continue to grow in acid waters of pH 5 but there are reports that reproduction is impaired in scarcely acid waters of approximately pH 6. Modelling population status on the basis of field data and laboratory bioassay, however, does not give a good correspondence between observed and predicted status, suggesting that other factors than water quality may be operating. These might include general environmental conditions such as temperature, latitude, lake size and complexity which are known to influence the variety of species in mixed communities. Another factor, not yet known in sufficient detail, could be the effect of transient changes in water quality associated with episodic events. On present evidence, the benefits of S emission control in bringing surface water quality within the range of acidity, calcium and aluminum concentrations suitable for fish seem quite uncertain. It is, however, demonstrably feasible and economic to improve conditions in acid susceptible areas by lime application, hydrological control, or vegetation management. These treatments can improve acid waters within shorter time scales than could be achieved by the widespread implementation of S control.

34958 (FWS/OBS—80(40.21), pp 82-96) **Fish species distribution as a function of lake acidity in the Northeastern United States.** Haines, T.A.; Jagoe, C.H.; Pauwels, S.J. (Univ. of Maine, Orono). Oct 1985. NTIS, PC A06/MF A01. File Number TI86900511. (CONF-8408184—Pt.1).

From 114. annual meeting of the American Fisheries Society; Ithaca, NY, USA (12 Aug 1984).

The Northeastern US now receives precipitation of annual weighted mean pH of 4.3 - 4.4. A substantial portion of the surface waters in this region are low in alkalinity and are believed to be vulnerable to acidification. In order to test the hypothesis that acidic precipitation has reduced the pH of sensitive surface waters and resulted in the elimination of sensitive fish species, a survey was made of the water chemistry and fish populations of 20 lakes in Maine. The lakes were located in areas where surface water alkalinity was low, had not been reclaimed or stocked, and were similar in physical characteristics. Five of the lakes had been previously surveyed by state agencies. The lakes had mean pH values of 4.7 to 7.0. There were no fish present in two lakes with pH 4.7 - 4.9. All other lakes with pH $>$ 5.0 contained fish. There was no relationship between the number of species or catch per unit effort and lake acidity for lakes that contained fish. Comparison of recent and historical water chemistry and fish species data for lakes that had previously been surveyed indicated that the lakes were slightly lower in pH and alkalinity, but the number and type of fish species present had not changed.

34959 (LMF—114, pp 20-24) **Generation and characterization of beryllium oxide aerosols for animal inhalation studies.** Hoover, M.D.; Mewhinney, J.A.; Eidson, A.F.; Finch, G.L.; Greenspan, B.J. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

A method is described to produce respirable particles of pure beryllium oxide at a temperature treatment of 500°C for use in metabolism and toxicity studies with laboratory animals. Solutions of beryllium oxalate or beryllium chloride and suspensions of beryllium hydroxide were nebulized to produce ^{7}Be-labeled poly-disperse particles. Conversion to beryllium oxide was incomplete when the nebulized particles were passed through a tube furnace at temperatures up to 575°C. Complete conversion was achieved by calcining samples of the collected particles in a muffle furnace for 16 h at 500°C. Particles produced by nebulizing and heat treating the beryllium solutions were hollow shells, while particles nebulized from beryllium hydroxide suspensions were micellular clusters morphologically similar to industrially produced beryllium oxide particles. 6 references, 4 figures, 1 table.

34960 (LMF—114, pp 45-47) **Technique for coating carbon black particles with benzo(a)pyrene.** Hanson, R.L.; Sun, J.D.; Wolff, R.K.; Rothenberg, S.J. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

Two techniques were evaluated for coating carbon black with 20% benzo(a)pyrene (BaP) or pyrene by weight. Carbon black particles were added to solutions of BaP in acetone, and the acetone was evaporated from the flask using rotary evaporation with a vacuum and ultrasonic bath agitation of the suspension. Only 2% of the BaP was found as unbound crystals in the product. This technique may be useful for coating large quantities of particles for use in inhalation exposures. Coating of carbon black particles packed in a gas chromatography column was also evaluated. This approach appeared to be most promising for applications requiring coatings less than 15%, and quantities of particles in the 0.1-2 g range. 2 references, 1 figure, 1 table.

34961 (LMF—114, pp 48-51) **Adsorption of pyrene by carbon black.** Rothenberg, S.J.; Poliner, J. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

The strength of attachment of polycyclic aromatic hydrocarbons (PAH) to particles (heat of adsorption) determines the equilibrium between vapor phase PAH and particle-bound PAH and might be a factor in determining the bioavailability of particle-bound PAH. In this study pyrene adsorption isotherms at 50°C and 65°C on carbon black were determined and isosteric heats of adsorption were derived. The isosteric heats of adsorption were less than the latent heat of vaporization by 10 kcal. 4 references, 2 figure.

34962 (LMF—114, pp 76-78) **Epithelial permeability to radiolabeled DTPA at four sites in the canine respiratory tract.** Wolff, R.K.; Kitzman, J.V.; Allen, P.A.; Muggenburg, B.A. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

Epithelial permeability was studied in six beagle dogs by measuring clearance of /sup 99m/Tc-DTPA after instillation at four sites in the respiratory tract. Elimination from the instillation sites was best described by first-order kinetics with the following half-times (X +/- SD): (1) 161 +/- 63 min in the nasal cavity at the level of the ethmoturbinates, (2) 159 +/- 90 min in the trachea, (3) 135 +/- 74 min at a 5th generation airway, and (4) 138 +/- 48 min in a peripheral site (approximately 10th generation airway). There were no statistically significant differences ($p < 0.05$) among the mean values for the various sites. 5 references, 1 figure, 1 table.

34963 (LMF—114, pp 84-87) **Role of lung macrophages in translocation of particles from lungs to lymph nodes.** Harmsen, A.G.; Muggenburg, B.A.; Snipes, M.B.; Bice, D.E. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

To determine if lung macrophages are responsible for particle translocation from the lungs to the tracheobronchial lymph nodes (TBLN), the authors instilled red fluorescent and green fluorescent microspheres into separate, but adjacent, areas of dog lung lobes. After 7 days, the TBLN contained macrophages that had ingested either all red or all green microspheres. In a second set of experiments, pulmonary alveolar macrophages (PAM), half of which were labeled with red microspheres and half with green microspheres, were instilled into unexposed lung lobes of dogs. After 5 days, the TBLN again had macrophages containing only one color of microsphere. These results indicate that the particles are translocated from alveoli to the TBLN in lung macrophages. 3 references, 2 figures.

34964 (LMF—114, pp 88-91) **Migration of neutrophils from the alveoli of the lung to the tracheobronchial lymph nodes.** Harmsen, A.G.; Mason, M.J.; Muggenburg, B.A.; Gillett, N.A.; Bice, D.E. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

The purpose of this study was to determine if neutrophils phagocytize particles in alveoli and carry them to the tracheobronchial lymph nodes (TBLN). The authors instilled autologous neutrophils, which had phagocytized either red or green fluorescent microspheres, into dog lungs. After 24 h, the TBLN of dogs instilled with neutrophils had numerous neutrophils containing fluorescent microspheres. In a second experiment, the authors instilled microspheres into lungs of normal dogs and dogs that were depleted of peripheral blood neutrophils by injections of hydroxyurea. Hydroxyurea treatment reduced neutrophil accumulation in the lung by 79% and particle translocation to the TBLN by 80% over a 40-h period. Results of these experiments indicate that during an inflammatory response, neutrophils can migrate into the alveolus, phagocytize particles, and then migrate to the TBLN. 5 references, 1 figure, 1 table.

34965 (LMF—114, pp 92-95) **Role of lung phagocytes in the clearance of particles by the mucociliary apparatus.** Harmsen, A.G.; Muggenburg, B.A.; Bice, D.E. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

The lungs of three Beagle dogs were instilled with 3.9 μm and 0.88 μm fluorescent microspheres. The trachea of each dog

was sequentially lavaged at 2 h, and at 1, 3, 7, 14, 21, 35, and 49 days after instillation. At 2 h, only about 12% of the microspheres in the tracheas were associated with phagocytes. By 1 day after instillation and for the remainder of the experiment, about 70% of the microspheres in the lavage fluids were within phagocytes. During the first 7 days, most of the cells containing microspheres in the tracheas were neutrophils. At 14 days, and for the remainder of the experiment, most of the microspheres were within pulmonary alveolar macrophages (PAM). These results suggest that both neutrophils and PAM may be important in the clearance of particles from the alveoli to the upper airways. 4 references, 3 figures.

34966 (LMF—114, pp 96-99) **Retention of ^{134}Cs-labeled aluminosilicate particles inhaled by dogs and guinea pigs - simulation model projects for humans.** Snipes, M.B.; McClellan, R.O. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

Beagle dogs and guinea pigs were used in inhalation studies to provide comparative data for deposition and fate of inhaled ^{134}Cs-labeled fused aluminosilicate particles (^{134}Cs-FAP). Results from tissue and excreta analyses for ^{134}Cs at various times after exposure were used to produce simulation models which accounted for the fate of the inhaled ^{134}Cs-FAP. These models, as well as results from a recent human experiment with radiolabeled FAP, were used to make projections for lung and lung-associated lymph node burdens in chronically exposed people. Results indicated that retention patterns for trace amounts of particles were comparable for Beagle dogs and guinea pigs. Both species may be useful in laboratory investigations directed to understanding the mechanisms of particle clearance in people. 4 references, 2 figures, 1 table.

34967 (LMF—114, pp 100-105) **Inhalation of BeO in dogs: a pilot study.** Mewhinney, J.A.; Hoover, M.D.; Greenspan, B.J.; Hahn, F.F.; Eidson, A.F. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

Three Beagle dogs received a single inhalation exposure to polydisperse aerosols of ^{7}BeO calcined at 500°C to achieve initial lung burdens of 1100, 460, and 160 μg BeO. Whole-body retention, tissue distribution, and excretion of Be was determined by nuclear counting of the incorporated ^{7}Be label. Whole-body retention of ^{7}Be during the 28-day observation period was not influenced by the initial lung burden, nor was the pattern of tissue distribution or excretion. Long-term retention of Be in the whole body had a half-time of 32 days. Initially, excretion of Be was greatest via feces, but urinary excretion dominated at 20 days after exposure. Granulomatous pneumonia and lymphoid hyperplasia of the tracheobronchial lymph nodes were observed at 28 days after exposure for dogs with the two highest initial lung burdens. These responses are consistent with an immune-mediated phenomenon. 4 references, 4 figures, 1 table.

34968 (LMF—114, pp 126-130) **Disposition of inhaled ^{14}C-dibenzo[c,g]carbazole in rats.** Bond, J.A.; Ayres, P.H.; Hirschfield, D.; Medinsky, M.A.; Cheng, Y.S.; McClellan, R.O. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

7-H-Dibenzo[c,g]carbazole (DBC), a mutagen and carcinogen, has been measured in environmental pollutants. The purpose of this project was to determine the toxicokinetics of inhaled DBC. Rats were exposed nose-only to 1.1 to 13 μg ^{14}C-DBC/L air for 1 h and the distribution metabolism of DBC measured. Lungs, liver, and kidneys contained high concentrations of ^{14}C. Elimination of ^{14}C from all tissues was rapid, with 60% to 98% cleared with a half-time of 1 to 16 h. Half-times for clearance of residual ^{14}C ranged between 1 and 14 days. Feces was the major route for excretion of ^{14}C with 95% of the total ^{14}C eliminated. 3 references, 2 figures, 2 tables.

34969 (LMF—114, pp 148-151) **Inhibitors of nasal mixed function oxidases.** Petridou-Fischer, J.; Dahl, A.R. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

The purpose of this study was to investigate the inhibitory properties of substituted aliphatic dioxolanes toward cytochrome P-450 mono-oxygenase activities with respect to (a) CO-binding, (b) hexamethylphosphoramide (HMPA) N-demethylase, and (c) ethoxyresorufin O-deethylase, in the nose of rabbits and rats as compared to liver. Results indicated that (a) HMPA N-demethylase inhibition parallels the reduction in the percent CO-binding, (b) cytochrome P-450 in the nasal mucosa is more readily inhibited by dioxolanes than the liver, and (c) lipophilicity is important in determining inhibitory activity in both nasal and liver microsomes. It appears that bulk properties are as important as lipophilicity in determining inhibition of the nasal microsomes. 5 references, 1 figure, 3 tables.

34970 (LMF—114, pp 152-155) **Hydrolytic enzymes in the respiratory tract.** Dahl, A.R.; Miller, S.C. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

Esters are a widespread class of organic compounds found both in industry and the environment. Because esters are often volatile and, therefore, readily inhaled, the capacity of respiratory tract as well as liver S-9 homgenates from rats, rabbits, and Syrian hamsters to hydrolyze a variety of esters was investigated. A new technique to determine hydrolysis rates by measuring carboxylic acid residues using ion chromatography was proven effective. The results indicated that esters, including potentially carcinogenic β-lactones, are readily hydrolyzed by respiratory tract enzymes. Species and tissue differences were apparent. 1 reference, 4 tables.

34971 (LMF—114, pp 280-285) **Planning experiments with a combination of insults.** Seiler, F.A. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

The analysis of experiments involving multiple insults requires data at a number of dose combinations. To be cost-effective, experiments have to be planned in a manner that provides data with an optimal information content. One method of approaching this goal, a phenomenological approach to the analysis, can be used to determine the best combinations of doses from two agents. Criteria derived from such an analysis are discussed in relation to the planning of experiments given different states of knowledge on the marginal risks of the toxicants involved.

34972 (LMF—114, pp 300-303) **Four-week inhalation exposures of F344/N rats to benzo(a)pyrene and nitropyrene aerosols, alone and in combination with Ga_2O_3 particles and/or SO_2 gas.** Wolff, R.K.; Hanson, R.L.; Hahn, F.F.; Henderson, R.F.; McClellan, R.O. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

F344/N rats were exposed nose-only 2 h/day, 5 days/wk, for 4 wk to nitropyrene (NP, 7.5 mg/m³) and benzo(a)pyrene (BaP, 7.5 mg/m³) alone and in combination with Ga_2O_3 particles (27 mg/m³) and SO_2 (5 ppm). Adverse responses were primarily related to the presence of Ga_2O_3 particles. Impairment of lung clearance, increased lung weight, and alveolar proteinosis and histiocytosis were found in all groups exposed to Ga_2O_3 particles. Biochemical changes in bronchoalveolar lavage fluid were indicative of an intense inflammatory responses to Ga_2O_3 particles. Little evidence for alterations due to the other exposure components was noted. 4 references, 4 tables.

34973 (LMF—114, pp 304-307) **Rat lung immune function following inhalation exposure to benzo(a)pyrene and 1-nitropyrene, in combination with Ga_2O_3 particles and SO_2.** Shopp, G.M.; Bice, D.E.; Harmsen, A.G.; Jarpe, M.A.; Wolff, R.K. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

To evaluate the effects of benzo(a)pyrene (BaP) and 1-nitropyrene (NP) on lung immune function, rats were exposed by inhala-

tion for 4 wk (2 h/day, 5 days/wk) to BaP or NP alone, coated onto Ga_2O_3 particles, and/or in combination with SO_2. There was a significant increase in the response of the IgM antibody cells (AFC) in the lung-associated lymph nodes (LALN) in all rats exposed to Ga_2O_3 due to an increase in LALN cell number but not due to an increase in AFC/10^6 cells. There was a decrease in phagocytic activity of alveolar macrophages in rats exposed to BaP coated on Ga_2O_3 particles but not in rats exposed to BaP alone, or Ga_2O_3 alone. 5 references, 3 tables.

34974 (LMF—114, pp 312-315) **Possible role of reduced glutathione in the development of pulmonary fibrosis in mice exposed to ozone.** Sun, J.D.; McLaughlin, S.I.; Pickrell, J.A.; Hahn, F.F.; Henderson, R.F. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

The ability of reduced glutathione (GSH) to protect against the development of pulmonary fibrosis induced by ozone (O_3) was tested. Mice were exposed by inhalation to 0, 0.2, 0.5, and 1.0 ppm of O_3 for 23 h/day, 7 days/wk, for 2 wk. At each exposure level mice were given drinking water containing 30 mM of L-buthionine-S,R-sulfoximine (BSO) to deplete in vivo levels of GSH. BSO treatment alone lowered lung GSH levels by 40%. O_3 exposures increased lung GSH levels up to 3.5-fold in both BSO-treated and untreated mice. However, mice treated with BSO and exposed to O_3 showed lung GSH levels that were ~ 50% lower than water-treated, O_3-exposed mice. Blood glutamylcysteine synthetase activity was decreased ~ 50% by BSO treatment alone, but was increased 2- to 2.5-fold by O_3 exposures. Thus, these data show that a suitable exposure model has been developed to study the possible role of GSH in protecting lungs against O_3-induced injuries. 2 references, 2 tables.

34975 (LMF—114, pp 322-326) **Immunopathologic effects of nickel subsulfide on the primate pulmonary immune system.** Haley, P.J.; Bice, D.E.; Muggenburg, B.A.; Hahn, F.F. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

The effects of nickel subsulfide (Ni_3S_2) on the pulmonary immune system were evaluated in cynomolgus monkeys that had been previously immunized and repeatedly challenged with sheep red blood cells in specific lung lobes. After instillation of Ni_3S_2 in one immunized and one control lobe of each monkey, bronchoalveolar lavage cells were evaluated for alterations in cell number and function. Neither numbers of antibody-forming cells nor natural killer (NK) cell conjugate formation was altered. Macrophage phagocytic activity was significantly decreased, and target cell killing by conjugate-forming NK cells was increased. Histologic sections of nickel-exposed lobes were characterized by mild proliferation of macrophages and lymphocytes within the interstitium and alveoli. 5 references, 4 figures.

34976 (LMF—114, pp 382-386) **Identification of natural killer cells in the nonhuman primate lungs.** Haley, P.J.; Bice, D.E.; Muggenburg, B.A.; Hahn, F.F. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

Bronchoalveolar lavage (BAL) samples from cynomolgus monkeys were evaluated for natural killer (NK) cells, with and without adherent cells removed, using a chromium-release assay, single-cell assay, and morphologic criteria. Results were compared to values for peripheral blood. Removal of adherent cells from BAL samples increased chromium release in those samples. However, the values remained markedly below those found for peripheral blood. In the single-cell assay, percent binding of target cells was greater in BAL samples than in blood. Killing of target cells by BAL cells was negligible as compared to 15% by blood NK cells. Morphologic criteria indicated that NK cells made up 15% of BAL lymphocytes as compared to 9% of blood lymphocytes. These data indicated that NK cells are present within the lungs, and, while capable of binding target cells, they are inhibited from killing by local suppressive effects. 5 references, 2 figures, 1 table.

34977 (LMF—114, pp 391-395) **Activation of nitrosamines to mutagens by rat and rabbit nasal, lungs, and liver S-9 homogenates.** Dahl, A.R.; Brooks, A.L. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

Nasal tissue is a frequent site of tumors after administration of N-nitrosamines. The purpose of this study was to determine if nasal tissue could activate N-nitrosamines to mutagens. Three aliphatic and two cyclic nitrosamines and diethanolnitrosamine were tested in the Ames Salmonella mutagenicity test with nasal, lung, and liver S-9 homogenates from rabbits and rats. The cyclic nitrosamines required S-9 homogenate to be mutagenic. The aliphatic nitrosamines were not mutagenic under any test conditions. Diethanolnitrosamine was a direct acting mutagen. The S-9 homogenates from all rabbit tissues were about equally effective activators. In the rat, only nasal S-9 homogenates activated the cyclic nitrosamines. 9 references, 4 figures.

34978 (LMF—114, pp 396-399) **Relationship between aryl hydrocarbon hydroxylase and nitroreductase to the binding of 1-nitropyrene.** Mitchell, C.E.; Lanwehr, L.P. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

The purpose of this study was to determine the roles of aryl hydrocarbon hydroxylase (AHH) and nitroreductive in the metabolism and binding of 1-nitropyrene (1-NP) to mammalian DNA. Pretreatment of mice with benzo(a)pyrene or Aroclor 1254 increased AHH activity in lung microsomes. However, 1-NP nitroreductase activity and total cytochrome P-450 content were unaffected. Lung microsomes from pretreated animals had increased ability to convert 1-NP to DNA-bound metabolites, particularly when the microsomal incubations were done under aerobic conditions. Incubations carried out under both aerobic and anaerobic conditions suggest that the nitroreductase pathway plays a minor role in microsomal metabolism of 1-NP in mouse lungs to products that bind DNA. 5 references, 3 figures, 1 table.

34979 (LMF—114, pp 400-403) **Effect of exposure to diesel exhaust on the covalent binding of ^{14}C-1-nitropyrene to tissue macromolecules in rats.** Medinsky, M.A.; Bond, J.A.; Sun, J.D.; Mauderly, J.L.; McClellan, R.O. Dec 1985. NTIS, PC A23/MF A01. File Number DE86008522.

In Inhalation Toxicology Research Institute annual report, October 1, 1984-September 30, 1985.

The purpose of this study was to determine if prior exposure of rats to diesel exhaust would affect the covalent binding of 1-nitropyrene, a constituent of diesel exhaust, to tissue macromolecules. Rats were exposed 7 h/day, 5 days/wk for 6 mo to clean air or to diluted diesel exhaust containing 3500 μg particles/m^3. Rats were then exposed to 350 μg ^{14}C-nitropyrene/m^3 air for 1 h. Total ^{14}C in tissues and ^{14}C covalently bound to macromolecules were determined at various times for up to 94 h after exposure. Pre-exposure to diesel exhaust did not have an effect on the amount of ^{14}C covalently bound to tissue macromolecules. Kidneys had the highest concentrations of covalently bound ^{14}C, and, thus, should be considered as one of the tissues at risk after exposure to 1-nitropyrene. 6 references, 3 tables.

34980 (PB—86-155777/XAB) **Plant exposure laboratory and chambers. Volume 1.** McFarlane, C.; Pfleeger, T. (Environmental Protection Agency, Corvallis, OR (USA). Environmental Research Lab.). Jan 1986. 35p. (EPA/600/3—86/007A). NTIS, PC A03/MF A01.

The research is to learn the factors that control plant uptake, translocation, and metabolism of anthropogenic organic chemicals. Understanding these processes is essential to predict food contamination and environmental damage from various agricultural and industrial pollutants. Contamination of plants is only one component, but since plants are the fulcrum upon which all nourishment systems depend, understanding the ways they become contaminated is critical to prudent production, transportation, and use of organic chemicals. These efforts to identify the controlling mechanisms of these phenomena require an understanding of the physiological parameters of the plants during uptake and translocation of the extra-

neous chemicals. Since the chemicals of interest are toxic and studies generally include ^{14}C as a label for monitoring chemical kinetics, containment is an important criterion. The paper describes the laboratory and support system, the exposure chambers, the computer system, and the plant hydroponic nursery built to accomplish this research.

34981 **(PB—86-155785/XAB) Plant exposure laboratory and chambers. Volume 2. Appendices 1 through 6.** McDowell, M. (Environmental Protection Agency, Corvallis, OR (USA). Environmental Research Lab.). Jan 1986. 286p. (EPA/600/3—86/007B). NTIS, PC A13/MF A01.

The paper describes the laboratory and support system, the exposure chambers, the computer system, and the hydroponic nursery built to accomplish research on uptake, translocation, and metabolism of toxic organic chemicals by plants. Understanding these processes and the physiological driving mechanisms is essential to predict food-chain contamination and environmental damage from various agricultural and industrial pollutants. Since the chemicals of interest are toxic and studies generally include ^{14}C as a label for monitoring chemical kinetics, containment was an important criterion. Containment and safety considerations are included.

34982 **(PNL—5584) Acute toxicity of smoke screen materials to aquatic organisms, white phosphorus-felt, red phosphorus-butyl rubber and SGF No. 2 fog oil. Final report.** Poston, T.M.; McFadden, K.M.; Bean, R.M.; Clark, M.L.; Thomas, B.L.; Killand, B.W.; Prohammer, L.A.; Kalkwarf, D.R. (Pacific Northwest Labs., Richland, WA (USA)). Apr 1986. Contract AC06-76RL01830. 167p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE86010450.

The acute toxicity of three obscurants was determined for nine freshwater organisms. The materials tested were white phosphorus-felt smoke, red phosphorus-butyl rubber (RP-BR) smoke, and smoke generator fuel (SGF) No. 2 fog oil (bulk and vaporized). The chemistry of WP-F and RP-BR smoke in water and the resulting effects on aquatic organisms are similar. Combustion of these two obscurants and their deposition in water leads to the formation of many complex oxy-phosphoric acids. Rates of hydrolysis of these complex products to ortho-phosphate were inconsistent and unpredictable over time. These products acidify water and produce toxic effects after exhausting the buffering capacity of the water. Acute 96 hr tests using Daphnia magna with neutralized and non-neutralized exposure solutions indicated that the presence of unidentified toxic component(s) acted independently of pH. At pH levels of 6.0 to 7.0, phosphorus combustion products precipitated out of solution leading to a bimodal toxic response in extended 96-hr tests with Daphnia magna. Most components of fog oil had low solubility in water. Saturation was apparent at approximately 0.1 to 0.3 mg/L total oil. Vaporization had no demonstrable effect on the chemistry or toxicity of the fog oil. Neither the bulk fog oil nor the vaporized fog oil was acutely toxic to freshwater animals at concentrations less than 10 mg/L total oil. In oil-water mixes in excess of 1.0 mg/L total oil, fog oil quickly separated and floated to the surface. The primary hazard associated with vaporized and bulk fog oil was the physical effect of oil fouling the organisms. Photolysis increased the concentration of water-soluble components of the fog oil. Acute toxicity was demonstrated in oil-water mixes (~10 mg/L total oil) of photolyzed bulk and vaporized fog oil. No difference in toxicity was observed between photolyzed and non-photolyzed dilutions of OWM at comparable levels of total oil.

34983 **Effects of ammonium nitrate aerosol exposure on lung structure of normal and elastase-impaired rats and guinea pigs.** Busch, R.H.; Buschbom, R.L.; Cannon, W.C.; Lauhala, K.E.; Miller, F.J.; Graham, J.A.; Smith, L.G. (Pacific Northwest Lab., Richland, WA). *Environmental Research;* **39**: No. 2, 237-252(Apr 1986). Contract AC06-76RL01830.

Groups of rats and guinea pigs with normal lungs and others with elastase-induced emphysema were exposed to NH_4NO_3 aerosols of 0.60 mass median aerodynamic diameter at 1 mg/m^3 for 6 hr/day, 5 days/week, for 4 weeks. Morphologic and morphometric studies were performed on lungs perfused with cacodylate-buffered 2% glutaraldehyde under 20 cm H_2O pressure at necropsy. The tissues were studied for pathologic change by light and electron microscopy; emphysema was evaluated by subgross and microscopic methods, including changes in mean alveolar chord length using scanning electron microscopy techniques. Elastase produced emphysema to a degree quantifiable by all criteria studied; however, it apparently obscured the effects of nitrate inhalation. The NH_4NO_3 exposure (compared to air alone) tended to increase values for pulmonary parameters in normal animals of both species and to decrease them in elastase-treated animals. The NH_4NO_3 exposure increased values for lung volume in rats, percentage area affected in elastase-treated rats, and chord length β in normal animals of both species. The responses to NH_4NO_3 were slight and were not accompanied by any detectable changes in alveolar structure. Therefore, the effects of NH_4NO_3 at this exposure level and duration, are regarded as biologically insignificant for rats and guinea pigs.

34984 **Trace element interactions affecting pulmonary macrophage cytotoxicity.** Fisher, G.L.; McNeill, K.L.; Democko, C.J. (Battelle Columbus Labs., Columbus, OH). *Environmental Research;* No. 1, 164-171(Feb 1986).

Effluents from the smokestacks of powerplants contain respirable particles that are enriched with a variety of biologically active trace elements. To determine the relative toxicity of trace elements in coal fly ash, the effects of selected compounds, alone and in combination, were evaluated in cultures of pulmonary alveolar macrophages. The inorganic compounds studied were ZnO, Na2SeO3, V2O5, NaAsO2, Mn3O4, and Ni3S2. Vanadium pentoxide was the most cytotoxic compound while selenium was the least toxic (approximately 100-fold less toxic than vanadium). After dose-response curves for each element were established, interactions between various compounds were studied by coexposure to trace elements at different concentrations. Selenium was completely antagonistic to the toxic effects of vanadium and slightly antagonistic to arsenic. In contrast to selenite, sulfite, a moiety with a similar redox potential, was not antagonistic to vanadium toxicity. Zinc was weakly antagonistic to the in vitro effects of nickel. No other chemical combinations displayed antagonistic, synergistic or additive effects on the function of the cultured macrophages.

34985 **Ethylene oxide dose and dose-rate effects in the mouse dominant-lethal test.** Generoso, W.M.; Cain, K.T.; Hughes, L.A.; Sega, G.A.; Braden, P.W.; Gosslee, D.G.; Shelby, M.D. (Oak Ridge National Lab., TN). *Environmental Mutagenesis;* No. 1, 1-7(1986).

In the dose-response study, male mice were exposed by inhalation to ethylene oxide (EtO) for 4 consecutive days. Mice were exposed for 6 hr per day to 300 ppm, 400 ppm, or 500 ppm EtO for a daily total of 1800, 2400, or 3000 ppm X hr (total exposures of 7200, 9600 and 12,000 ppm X hr), respectively. In the dose-rate study, mice were given a total exposure of 1800 ppm X hr per day, also for 4 consecutive days, delivered either at 300 ppm in 6 hr, 600 ppm in 3 hr, or 1200 ppm in 1.5 hr. Quantitation of dominant-lethal responses was made on matings involving sperm exposed as late spermatids and early spermatozoa, the most sensitive stages to EtO. In the dose-response study, a dose-related increase in dominant-lethal mutations was observed, the dose-response curve proved to be nonlinear. In the dose-rate study, increasing the exposure concentrations resulted in increased dominant-lethal responses.

34986 **Aryl hydrocarbon hydroxylase tissue-specific activities: evidence for baseline levels in mammalian tissues.** Uziel, M.; Griffin, G.D.; Walsh, P.J. (Oak Ridge National Lab., TN). *Journal of Toxicology and Environmental Health;* **16**: No. 6, 727-742(1985). Contract AC05-84OR21400.

The tissue-specific activities of arylhydrocarbon hydroxylase benzo[a]pyrene [AHH(BaP)] in human, mouse, rat, and hamster tissues have been reviewed. Three categories of AHH activities are defined: baseline values from tissues that have been protected from adventitious exposures to AHH inducers; background levels from tissues where there have been no overt measures to protect against exposure; and induced levels resulting from overt exposure to chemical inducers. Evidence that the baseline category exists is derived from the observations that an upper limit of AHH tissue-specific activity of about 1.5 nmol/h x g tissue occurs in human placenta, human foreskin, lymphocyte, and epitheliod and fibroblastoid cell lines; mouse lung and liver; rat fetal liver, and noninducible rat

cell lines from lung, liver, embryo kidney, and adrenals; and hamster kidney. The collected values for nonexposed tissues range from 0.02 nmol/h x g to values less than 1.5 nmol/h x g. The most consistent observation of this type was from human placental material from nonsmoking mothers. Animals raised under standard laboratory conditions without special dietary precautions show background AHH activities that range from 2 nmol/h x g to 200 nmol/h x g in portal of entry tissues such as liver, lung, and intestines. Almost all tissue samples showed induced AHH levels of up to 500 nmol/h x g when those tissues were overtly exposed to substances containing chemical inducers of AHH. Measurements of placental AHH from smoking mothers showed that more than 95% of those samples had AHH values exceeding 2.5 nmol/h x g.

34987 **Lung and pleural free-cell responses to the intrapulmonary deposition of particles in the rat.** Lehnert, B.E.; Valdez, Y.E.; Bomalaski, S.H. (Los Alamos National Lab., NM). *Journal of Toxicology and Environmental Health;* 16: No. 6, 823-839(1985).

The authors investigated the lung's free-cell response in the rat to the intrapulmonary instillation of 4×10^8 1.9 μm poly-styrene microspheres and determined the contributions of newly arrived blood monocytes to the macrophagic response over a 30-d period. As of 24 h after deposition, the lavageable population size increased approximately fivefold. Most of the increase in the free cell population was due to a recruitment of polymorphonucleated leukocytes (PMN), although the size of the alveolar macrophages (AM) population nearly doubled. Only about 13% of the AM on d 1 were positive for myeloperoxidase activity, suggesting that recruitment of mononuclear phagocytes from the blood compartment plays a limited role in the early expansion of the AM pool in the rat. The authors also investigated how the pleural cell population might be affected during the lung's free-cell response to the particulate burden. No acute influx of PMN into the pleural space (PS) accompanied the early free-cell response; the chemotactic factors initially involved in recruitment of the PMN into the lung apparently did not reach the PS in significant concentrations. On the other hand, the numbers of macrophages in the PS were significantly elevated on d 1 and 14 after particle deposition in the lung.

5604 Other Environmental Pollutant Effects

34988 **(PB—86-162385/XAB) Blood-brain barrier permeation in the rat during exposure to low-power 1.7-GHz microwave radiation.** Ward, T.R.; Ali, J.S. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). 1985. 15p. (EPA/600/J—85/321). NTIS, PC A02/MF A01.

The permeability of the blood-brain barrier to high-and low-molecular-weight compounds has been measured as a function of continuous wave (CW) and pulsed microwave radiation. Adult rats, anesthetized with pentobarbital and injected intravenously with a mixture of ^{14}C-sucrose and ^{3}H-insulin, were exposed for 30 min at a specific absorption rate of 0.1 W/kg to 1.7 GHz CW and pulsed (0.5-us pulse width, 1000 pps) microwave radiation. Following exposure, the brain was perfused and sectioned into nine regions and the radioactivity in each region was counted. During identical exposure conditions, temperatures were measured in eight of the brain regions using a nonperturbing thermistor probe. No change in uptake of either tracer was found in any region as compared to sham-exposed animals.

34989 **(DOE-tr—6010663) Incidence of cancer in the Alfta Area.** Rodvall, Y.; Feychting, M.; Ahlbom, A. (National Inst. of Environmental Medicine, Stockholm (Sweden)). 1985. Translation source information not available . 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010663.

An epidemiological study was conducted of the incidence of cancer in a population of people living with 200 meters of a 200 kV power line to determine whether proximity to the lines causes an increased incidence of cancer. The results indicate a total of 18 cases occurred in the area, compared to an expected 19.9. (ACR)

57 HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 35186, 35187

34990 **(MSHA/IR—1179) Injury experience in nonmetallic mineral mining (except stone and coal), 1984.** (Mine Safety and Health Administration, Denver, CO (USA). Denver Technical Support Center). 1986. 300p. NTIS, PC A13/MF A01. File Number DE86901434.

This report reviews in detail the occupational injury and illness experience of nonmetallic mineral mining (except stone and coal) in the United States for 1984. Data reported by operators of mining establishments concerning work injuries are summarized by work location, accident classification, part of body injured, nature of injury, occupation, and principal type of mineral. Related information on employment, worktime, and operating activity also is presented. Data reported by independent contractors performing certain work at mining locations are depicted separately in this report.

34991 **(MSHA/IR—1181) Injury experience in sand and gravel mining, 1984.** (Mine Safety and Health Administration, Denver, CO (USA). Denver Technical Support Center). 1986. 104p. NTIS, PC A06/MF A01. File Number DE86901436.

This report reviews in detail the occupational injury and illness experience of sand and gravel mining in the United States for 1984. Data reported by operators of mining establishments concerning work injuries are summariezed by work location, accident classification, part of body injured, nature of injury, and occupation. Related information on employment, worktime, and operating activity also is presented. Data reported by independent contractors performing certain work at mining locations are depicted separately in this report.

58 GEOSCIENCES

5801 Geology And Hydrology

REFER ALSO TO CITATION(S) 33838, 33840, 33843, 33852, 34369, 34395, 34856, 35172

34992 **(INS-R—328) Radiocarbon dating for contributors.** Jansen, H.S. (Department of Scientific and Industrial Research, Lower Hutt (New Zealand). Inst. of Nuclear Sciences). Jun 1984. 73p. NTIS (US Sales Only), PC A04/MF A01. File Number DE86702158.

This report describes the radiocarbon facility at the Institute of Nuclear Sciences, and is written for potential contributors, current users, and for those who advise others. The report briefly outlines the principles and practices of C-14 dating; with emphasis on factors that enable contributors to judge whether C-14 work is appropriate, and to assist them with the procedures to be followed in order to get the best results. Age determinations, being the main requirements by contributors, have been discussed in detail.

34993 **(INS-R—331) Derivation of 14C dating standards for fresh-water shell-fish.** Currie, D.R. (Department of Scientific and Industrial Research, Lower Hutt (New Zealand). Inst. of Nuclear Sciences). Oct 1984. 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86702160.

14C analyses of hyridella shell-fish from four different localities were used to determine suitable 14C dating standards for these shell-fish. For each locality the dating standard deduced was considerably less than the 0.95 NBS oxalic acid standard, and notably the estimated standard for a group of Lake Taupo shell-fish was estimated to be only 55% to 62% of the NBS oxalic acid standard level. Variability of hyridella 14C standards with locality and time may limit the confidence that can be placed in radiocarbon dates from hyridella.

34994 **(NZGS-G—79) Seven climatic cycles in New Zealand during the last half-million years.** Te Punga, M.T. (Department of Scientific and Industrial Research, Lower Hutt (New Zealand). Geological Survey). 1984. 21p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86702162.

At Upper Hutt, New Zealand (Lat. 41 deg 07' S) there is a sequence of seven loess/soil pairs that represents seven climatic cycles spanning the last half-million years (Fig. 1). Each loess layer accumulated in a dry, cool, possibly periglacial environment with an average temperature about 4 deg C to 6 deg C lower than at present. The five oldest soils (paleosols) are red and each was probably formed in a seasonally humid climate with a hot dry period, with a mean annual temperature above 15.5 deg C and an annual rainfall of more than 1000 mm. Although the present soil and the youngest paleosol are not red at Upper Hutt both are strongly coloured. The sequence, known to be of Brunhes age, is divided by the Mangaroa Ash (340,000 yr B.P.), the Mt Curl Tephra (230,000 yr B.P.) and the Aokautere Ash (Kawakawa Tephra) (20,600 yr B.P.). Correlation with the delta oxygen isotope stages of deep-sea cores indicates that the Aokautere Ash was deposited in "glacial" stage 2, the Mt Curl Tephra in "interglacial" stage 7,1 and the Mangaroa Ash probably near the beginning of "interglacial" stage 9. The oldest loess layer is correlated with "glacial" stage 14 that began 517,000 years ago; the younger six loess layers are assigned to "glacial" stages 12, 10, 8, 6, 4 and 2 respectively, and the six paleosoils are assigned to "interglacial" stages 13, 11, 9, 7, 5 and 3; the present day soil is assigned to "interglacial" stage 1 (Fig. 1). The seven cyclic climatic changes recorded in the Upper Hutt sequence apparently indicate a response to cyclic changes in the earth's orbital parameters and the alternating climatic regime at Wellington supports the suggestion that cyclic climatic changes have been globally synchronous for the past 500,000 years.

34995 **(NZGS-PAL—69) Wellington Quaternary palynology. Aranuian and Otiran pollen diagrams from Soil Bureau site, Taita and Wallaceville Swamp, Hutt Valley, New Zealand.** Harris, W.F.; Mildenhall, D.C. (Department of Scientific and Industrial Research, Lower Hutt (New Zealand). Geological Survey). 1984. 27p. NTIS (US Sales Only), PC A03/MF A01. File Number DE86702163.

Pollen samples from a profile at Taita indicate a grassland environment prior to and immediately after the deposition of the Aokautere Ash (Kawakawa Tephra) approximately 21,000 years B.P. This grassland gradually gave way to a Nothofagus menziesii montane forest followed by an abrupt change to a N. "Fusca" group dominant forest which continues to the top of the section. The top few centimetres of the profile may have been deposited in post-European time. The abrupt change in the species of beech represents an unconformity of unknown duration. Pollen samples from a number of profiles at Mangaroa (Wallaceville Swamp) indicate a change from a cool environment (Gramineae plus Phyllocladus) through successive phases of Nothofagus menziesii, Podocarpus species, Dacrydium cupressinum to Nothofagus "fusca" group close to the present day. These results are presented in an historical context based on notes left by Dr W.F. Harris, supplemented with additional data by the junior author.

5802 Geophysics

REFER ALSO TO CITATION(S) 33670, 33835, 33850, 34724, 34829

34996 **(NUREG/CR—4580) Stony Brook Seismic Network on Long Island, New York: operation and maintenance. Final report, September 1979-March 1985.** Liebermann, R.C.; Thurber, C.H. (State Univ. of New York, Stony Brook (USA). Dept. of Earth and Space Sciences). Apr 1986. 110p. NTIS, PC A06/MF A01 - GPO. File Number TI86901342.

The seismology group in the Department of Earth and Space Sciences at the State University of New York at Stony Brook currently operates two short period seismic stations on Long Island, New York. These stations are part of the larger Northeastern United States Seismic Network (NEUSSN) operated by several university groups in New York, New Jersey, Pennsylvania and New England. The Stony Brook stations provide data for specific studies of earthquakes in the vicinity of Long Island, including southeastern New England and offshore areas. This report discusses network operation and results of research using NEUSSN and related data.

5803 Mineralogy, Petrology, And Rock Mechanics

REFER ALSO TO CITATION(S) 33834, 33835, 33839, 33840, 33863

34997 **(DOE/CH—17) Waste package environment studies. FY 1984 annual report.** Pederson, L.R.; Gray, W.J.; Hodges, F.N.; McVay, G.L.; Moore, D.A.; Rai, D.; Schramke, J.A. (Pacific Northwest Labs., Richland, WA (USA)). Mar 1986. Contract AC06-76RL01830. 130p. (PNL—5613). NTIS, PC A07/MF A01; GPO Dep. File Number DE86010857.

Tests were conducted by Pacific Northwest Laboratory in FY 1984 to examine the influence of heat and radiation on the chemical environment of a high-level nuclear waste package in a repository in salt and to determine the solubility of key radionuclides in site-specific brines. These tests are part of an ongoing effort by the Waste Package Program, whose objective is to help develop a data base on package components and system interactions necessary to qualify a nuclear waste package for geologic disposal. Specifically, tests performed in FY 1984 involved alpha and gamma radiolysis of brines, americium solubility in brines, the influence of heat and radiation on rock salt, and the influence of temperature on brine chemistry.

34998 **(UCRL—15811) Laboratory measured material properties of granodiorite Climax Stock, Nevada Test Site.** Lingle, R.; Pratt, H. (Terra Tek, Inc., Salt Lake City, UT (USA)). Aug 1978. Contract W-7405-ENG-48. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010550.

The physical, mechanical and thermal properties of the granodiorite from the Climax Stock, Nevada, were measured. These properties are required to (1) evaluate and calibrate the borehole instrumentation and (2) assess the effects of thermal loading on crystalline rock. Computer calculations of the deformations, temperatures and stress fields require material properties as input data. A summary of the data and a brief description of the techniques employed are included.

34999 **(UCRL—53673) Estimates of in situ deformability witn an NX borehole jack, Spent Fuel Test - Climax, Nevada test site.** Patrick, W.C.; Yow, J.L. Jr.; Axelrod, M.C. (Lawrence Livermore National Lab., CA (USA)). Dec 1985. Contract W-7405-ENG-48. 46p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86010778.

A series of borehole modulus measurements was obtained at the Spent Fuel Test - Climax (SFT-C) facility following removal of heat sources and a subsequent 1-year cooling period. A total of 212 measurements were obtained using a standard hardrock NX borehole (Goodman) jack. The results of 64 measurements made at the site before heating were reanalyzed for comparison with the post-heat data. Modulus values were calculated from the straight-line portion of the pressure vs displacement curves. Although the deformation modulus was observed to be highly variable, models were developed to explain much of this variability. Typically, spacial effects, anisotropy, and heating effects were present. The test results indicate that the deformation modulus tended to increase in the pillars between the underground openings where temperatures increased about 10°C above the ambient 24°C during the SFT-C. Conversely, a decrease in modulus was observed where temperatures were near 60°C for a three-year period. In most cases, we found the modulus values to be slightly higher for vertical than for horizontal loading. There was a tendency for the modulus to be lower near excavated openings. While this effect was not ubiquitous, it was statistically significant.

35000 **Observations of borehole deformation modulus values before and after extensive heating of a granitic rock mass.** Patrick, W.C.; Yow, J.L.; Caxelrod, M.C. (Lawrence Livermore National Lab., CA). pp 851-858 of Research and engineering applications in rock masses. Volume 2. Ashworth, E. Accord, MA; A.A. Balkema Pub. (1985). (CONF-850671—).

From 26. U.S. symposium on rock mechanics; Rapid City, SD, USA (26 Jun 1985).

An extensive campaign of in situ deformation modulus measurements was recently completed using a standard NX borehole jack. These results were obtained in a granite intrusive where spent nuclear-fuel assemblies and electrical heaters had raised the rock temperatures 10°C to 40°C above ambient. We present an analysis of temperature effects based on 41 preheat and 63 post-heat measurements in three boreholes. Using analysis of covariance statistical techniques, we found that the deformation modulus is affected by heat, loading direction, and position within the borehole. The analysis also uncovered a significant interaction between the effects of heating and loading direction. We used 123 measurements from the same boreholes to evaluate the "Draft Standard Guide for Estimating the In Situ Modulus of Rock Masses Using the NX-Borehole Jack" which was recently proposed by Heuze. In particular, we examined the criterion for screening measurements in those cases where contact between the jack platen and the borehole wall was incomplete. We found that the proposed screen appears to operate randomly on the data and is therefore ineffective.

35001 **Thermal-cycle testing of the G-tunnel heated block.** Zimmerman, R.M.; Wilson, M.L.; Board, M.P.; Hall, M.E.; Schuch, R.L. (Sandia National Labs., Albuquerque, NM). pp 749-758 of Research and engineering applications in rock masses. Volume 2. Ashworth, E. Accord, MA; A.A. Balkema Pub. (1985). (CONF-850671—). Contract AC04-76DP00789.

From 26. U.S. symposium on rock mechanics; Rapid City, SD, USA (26 Jun 1985).

Volcanic tuffs are being considered by the Department of Energy (DOE) as a medium for disposal of high-level radioactive wastes. The Nevada Nuclear Waste Storage Investigations (NNWSI) Project was established in 1977 to evaluate such disposal in geologic formations on or adjacent to the Nevada Test Site (NTS). Sandia National Laboratories (SNL), as one of the NNWSI project participants, is responsible for the rock mechanics program to support the design of underground portions of a radioactive-waste repository in tuff. A rock mechanics field testing program is underway in G-Tunnel in Rainier Mesa on the NTS, where tuffs similar to those at Yucca Mountain, the potential candidate site, are found; later experiments are planned as part of the exploratory shaft investigations in Yucca Mountain. Science Applications International Corporation has been under contract to SNL to prepare and install instrumentation and control systems and to aid in the evaluation of the heated-block rock mechanics experiment.

35002 **The use of field data to evaluate and improve drift response models for the Waste Isolation Pilot Plant (WIPP).** Morgan, H.S.; Stone, C.M.; Krieg, R.D. (Applied Mechanics Div. I, Sandia National Labs., Albuquerque, NM). pp 769-776 of Research and engineering applications in rock masses. Volume 2. Ashworth, E. Accord, MA; A.A. Balkema Pub. (1985). (CONF-850671—). Contract AC04-76DP00789.

From 26. U.S. symposium on rock mechanics; Rapid City, SD, USA (26 Jun 1985).

The Waste Isolation Pilot Plant (WIPP) is currently being excavated near Carlsbad, New Mexico by the U.S. Department of Energy as a research and development facility to demonstrate the safe disposal of defense generated radioactive waste in bedded salt. Structural response data collected from underground rooms and drifts at the WIPP will ultimately be used to evaluate and improve computational models for predicting time-dependent room deformations caused by salt creep. An initial evaluation, based on a comparison of computed and measured room closures for one of the early WIPP excavations known as the South Drift, has already been completed. Some of the highlights of that evaluation are presented in this paper. First the finite element model used to compute the response of the South Drift is described. Then closure measurements from the South Drift are presented, and comparisons with the calculations are made. Attempts to resolve the resulting discrepancies are summarized next, and finally some directions for future work are offered.

35003 **Implications about in situ stress at Yucca Mountain.** Bauer, S.J.; Holland, J.F.; Parrish, D.K. (Sandia National Labs., Albuquerque, NM). pp 1113-1120 of Research and engineering applications in rock masses. Volume 2. Ashworth, E. Accord, MA; A.A. Balkema Pub. (1985). (CONF-850671—). Contract AC04-76DP00789.

From 26. U.S. symposium on rock mechanics; Rapid City, SD, USA (26 Jun 1985).

Volcanic tuffs under Yucca Mountain on the Nevada Test Site (NTS) are being considered as potential media for geologic disposal of radioactive waste. Calculations in support of site evaluation, repository design, and performance assessment require accurate estimates of the in situ stresses and the variability in the stress state within Yucca Mountain. This paper uses the regional geologic studies that pertain to the stress state at the NTS, stress measurements in Yucca Mountain, and stress measurements in nearby Rainier Mesa, in conjunction with finite element calculations to estimate the in situ stresses at Yucca Mountain. Based on these data, values of lateral earth-stress coefficients (K^o) in the range $0.3 < K^o < 0.8$ are reasonable for repository depths in thermomechanical analyses.

35004 **A strategy for future laboratory rock mechanics programs.** Butcher, B.M.; Jones, A.K. (Sandia National Labs., Albuquerque, NM). pp 883-894 of Research and engineering applications in rock masses. Volume 2. Ashworth, E. Accord, MA; A.A. Balkema Pub. (1985). (CONF-850671—). Contract AC04-76DP00789.

From 26. U.S. symposium on rock mechanics; Rapid City, SD, USA (26 Jun 1985).

While progress in the authors' laboratory is encouraging with regard to load path control of laboratory rock mechanics tests, the results clearly demonstrate how limited the capabilities are in this area: almost all testing continues to be axisymmetric in nature. Even tests duplicating the simplest stress states of interest to the analysts, plane strain, with three independent principal stresses, and plane stress, with two independently varying principal stresses, are beyond the reach of most laboratories. At the same time, studies of the relationship of microcrack growth to brittle nature of rock deformation provide strong motivation for exploring path dependence. These observations have convinced us that in order to address some of these very complex questions we need to strive to achieve a true three-dimensional testing capability as soon as possible.

5805 Oceanography

35005 **(SAND—85-2806) Status and outlook of ocean modeling research dispersion and related applications.** Marietta, M.G.; Robinson, A.R. (Sandia National Labs., Albuquerque, NM (USA); Harvard Univ., Cambridge, MA (USA). Div. of Applied Sciences). Apr 1986. Contract AC04-76DP00789. 123p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE86010632.

This report describes a working, interconnected, multiscale hierarchy of transport models assembled under the auspices of Sandia National Laboratories (SNL) to study ocean dispersion and transport related to assessing the feasibility of waste disposal in deep ocean sediments. The work was performed by scientists from SNL, Harvard University, and other US and international institutions, and builds upon the results of two decades of basic research in ocean modeling. However, we focus here on SNL accomplishments and contributions. The report describes the new model system and its applications by collecting, expanding, synthesizing, and updating earlier papers and reports. Its purpose is to inform, to make available latest scientific developments and selected results in a concise and timely fashion, and to highlight research directions for the immediate future. The report is aimed broadly at oceanographic scientists and modelers. Thus, general familiarity with basic

oceanographic and modeling concepts, and related terminology is assumed.

64 PHYSICS I

6401 Astrophysics And Cosmology

REFER ALSO TO CITATION(S) 34411, 34412, 35045, 35069

35006 **(AD-A—163668/7/XAB) Frontiers of astronomy and astrophysics. Invited papers presented at the European regional astronomy meeting (7th) held at Florence, Italy on 12-16 December 1983.** (Osservatorio Astrofisico di Arcetri, Florence (Italy)). 1984. 233p. NTIS, PC A11/MF A01.

Partial contents: Optical Telescopes of the Future; Comet Halley; The Early Solar System; Elemental and Isotopic Ratios in the Outer Solar System; Abundance of the Elements in the Sun; Coronal Magnetic Heating in the Sun and in Late-type Stars; The First Stellar Generations; Massive Stars--Evolution and properties in galaxies; Magnetic Processes during Star Formation; Some Regularities in Violent Star Formation Regions; A New Determination of the Interstellar Extinction Law in the Infrared; Pulsars and Supernova Remnants; Accretion Discs; Evolutionary Processes in X-ray Binaries and Wide Radio Pulser Binaries; Optical Emission from X-Ray and Gamma-Ray Bursters; Bursts of Star formation in Galaxies; Quasar Pairs; x-ray Properties of Quasars; Measurements of the 3.46 cm Line of He(3+); CCD Technology for Astronomy; Measurement of Transition Probabilities for Intersystem Lines of Atomic Ions Used in Diagnosis of Astrophysical Plasmas.

35007 **(AD-A—164425/1/XAB) Automated system for resolving the position of solar radio bursts. Interim scientific report.** Gaunt, D.N. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). 19 Aug 1985. 16p. (AFGL-TR—85-0179). NTIS, PC A02/MF A01.

A swept-freqency interferometer system such as the one in operation at Sagamore Hill observatory, described in AFGL Tech report 76-0194 1976, contains in its output data, precise information that can determine, in a plane resolution, the position of a radio source on the solar disk within 1.3 min arc. This information is the frequency separation between the interference fringes within the spectrum observed. A system that could, automatically, convert this information to degrees and minutes of arc is described.

35008 **(AD-A—164458/2/XAB) Peak-flux-density spectra of large solar radio bursts and proton emission from flares. Environmental research papers, July 1981-July 1985.** Cliver, E.W.; McNamara, L.F.; Gentile, L.C. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). 19 Aug 1985. 61p. (AFGL-TR—85-0180). NTIS, PC A04/MF A01.

The relationship between U-shaped peak-flux-density microwave spectra and solar proton events was re-examined for approx 200 large (Sp(> or = 2GHz) > or = 800 solar flux uits (sfu) microwave burst (1965 - 1979). The radio spectra fell into two basic classes: (a) U-shaped with two maxima (> or = 800 sfu) in the range from 200 MHz to > or = 10 GHz (59% of all events), and (b) cutoff spectra with a maximum > or = 800 sfu at f > or = 2 GHz and Sp (200 MHz) < 100 sfu (18%). Nine percent of the events had intermediate spectra with a maximum > or = 800 sfu at f > or = 2 GHz and 100 sfu < or = Sp (200 MHz) < 800 sfu. The authors were unable to classify 15% of the events because of incomplete data. The associations of the three classes of spectra with Type II (and/or Type IV) meter-wavelenght bursts and > 10-MeV proton events of any size (> or = 0.01 pr per sq cm per sec per sr) are as follows: U-shaped Type II/IV (90% of large microwave bursts with U-shaped spectra are associated with Type II/IV events), protons (77%); intermediate Type II/IV (78%), protons (73%); and cutoff Type II/IV (22%), protons (33%). These statistics affirm various lines of evidence linking coronal shock waves and interplanetary proton events. They also suggest that the meter wavelength branch of the U-shaped spectrum may be attributable to second phase (vs flash phase) accelerated electrons.

35009 **(FNAL/Pub—86/40-A) Microwave background anisotropy and decaying cold particle scenarios.** Kolb, E.W.; Olive, K.A.; Vittorio, N. (Fermi National Accelerator Lab., Batavia, IL (USA); Minnesota Univ., Minneapolis (USA). Dept. of Physics; California Univ., Berkeley (USA). Dept. of Astronomy). Mar 1986. Contract AC02-76CH03000;AC02-83ER40105. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011024.

Decaying particle scenarios for galaxy formation are subject to constraints from limits on the anisotropy of the microwave background radiation. In this paper we obtain limits on the properties of decaying cold dark matter. 25 refs., 2 figs.

35010 **(FNAL/Pub—86/62-A) Double inflation.** Silk, J.; Turner, M.S. (California Univ., Berkeley (USA). Dept. of Astronomy; Fermi National Accelerator Lab., Batavia, IL (USA); Chicago Univ., IL (USA). Enrico Fermi Inst.). Apr 1986. Contract AC02-76CH03000;AC03-76SF00098. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86011022.

The Zel'dovich spectrum of adiabatic density perturbations is a generic prediction of inflation. There is increasing evidence that when the spectrum is normalized by observational data on small scales, there is not enough power on large scales to account for the observed large-scale structure in the Universe. Decoupling the spectrum on large and small scales could solve this problem. As a means of decoupling the large and small scales we propose double inflation (i.e., two episodes of inflation). In this scenario the spectrum on large scales is determined by the first episode of inflation and those on small scales by a second episode of inflation. We present three models for such a scenario. By nearly saturating the large angular-scale cosmic microwave anisotropy bound, we can easily account for the observed large-scale structure. We take the perturbations on small scales to be very large, δrho/rho ≅ 0.1 to 0.01, which results in the production of primordial black holes (PBHs), early formation of structure, reionization of the Universe, and a rich array of astrophysical events. The Ω-problem is also addressed by our scenario. Allowing the density perturbations produced by the second episode of inflation to be large also lessens the fine-tuning required in the scalar potential and makes reheating much easier. We briefly speculate on the possibility that the second episode of inflation proceeds through the nucleation of bubbles, which today manifest themselves as empty bubbles whose surfaces are covered with galaxies. 37 refs., 1 fig.

35011 **(FNAL/Pub—86/66-A) Possible significance of a new dimensionless ratio in cosmology.** Turner, M.S.; Carr, B.J. (Fermi National Accelerator Lab., Batavia, IL (USA); Chicago Univ., IL (USA). Enrico Fermi Inst.; Queen Mary Coll., London (UK). School of Mathematical Sciences). May 1986. Contract AC02-76CH03000. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011026.

Observations suggest that the mass density of the Universe is dominated, not by ordinary matter, but by exotic particles which are a relic of the Big Bang. In this case, a new dimensionless cosmological ratio arises, the ratio of the mass density in ordinary matter to that in exotic matter, whose value is about 0.1. A priori it might seem remarkable that this ratio should be so close to unity. However, we point out that, for many exotic dark matter candidates, the ratio is related to the fundamental scales of particle physics. A value of order unity arises naturally providing rather simple relationships exist between these scales.

35012 (INIS-SU—321, pp 286-296) **On gravitational radiation of an inclined rotator.** Gal'tsov, D.V.; Tsvetkov, V.P. (Kalininskij Gosudarstvennyj Univ., USSR). 1984. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE86780458. (CONF-8407160—Vol.1).

From 7. seminar on problems of high energy physics and quantum field theory; Protvino, USSR (1 Jul 1984).

Gravitational radiation of a quickly rotating pulsar is discussed on the basis of inclined rotator model. The generation effect of the first harmonics of pulsar gravitational radiation due to the contribution of Newton tensions is investigated. An experiment on searching the gravitational radiation of a quickly rotating pulsar is

proposed. The experiment consists in measuring Riemann's tensor of gravitational waves propagating from the chosen pulsar at two frequencies: the frequency of pulsar rotation and the corresponding doublet frequency. It is shown that according to the forecasts of the general theory of relativity the radiation at the first harmonics should be absent only in case of the orthogonality of the magnetic axis to the axis of rotation (which is unlikely).

35013 **(LA-UR—86-1216) Intense soft x-rays from RS Ophiuchi during the 1985 outburst.** Mason, K.O.; Cordova, F.A.; Bode, M.F.; Barr, P. (Los Alamos National Lab., NM (USA); Mullard Space Science Lab., Dorking (UK); Preston Polytechnic (UK). Div. of Physics and Astronomy; European Space Operations Centre, Darmstadt (Germany, F.R.). EXOSAT Observatory). 1985. Contract W-7405-ENG-36. 11p. (CONF-851272—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010175.

From Conference on RS Ophiuchi and the recurrent nova phenomenon; Manchester, England (1 Dec 1985).

Intense soft x-ray emission with a characteristic temperature of a few million degrees has been detected from the recurrent nova RS Oph approximately two months after its January 1985 optical outburst. This is the first detection of x-rays from such a system at outburst. The x-radiation is interpreted as emission from circumstellar gas that is shock heated by the passage of the blast wave from the nova explosion. The rapid decline of the x-ray flux between about 60 and 90 days after the outburst probably occurs because the blast wave has reached the edge of the volume filled, between outbursts, by the stellar wind of the red giant component of the binary system. Residual x-ray emission detected from RS Oph 250 days after the outburst is interpreted as coming from the surface of a white dwarf, at a temperature of ~300,000K, where thermonuclear burning is persisting. 7 refs., 3 figs.

35014 **(LA-UR—86-1524) Nuclide production by primary cosmic-ray protons.** Reedy, R.C. (Los Alamos National Lab., NM (USA)). 1986. Contract W-7405-ENG-36. 18p. (CONF-860375—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE86011268.

From Lunar and planetary science conference; Houston, TX, USA (17 Mar 1986).

The production rates of cosmogenic nuclides in the solar system and in interstellar space were calculated for the primary protons in the galactic and solar cosmic rays. At 1 AU, the long-term average fluxes of solar protons usually produce many more atoms of a cosmogenic nuclide than the primary protons in the galactic cosmic rays (GCR), the exceptions being nuclides made only by high-energy reactions (like ^{10}Be). Because the particle fluxes inside meteorites and other large objects in space include many secondary neutrons, the production rates are much higher and ratios inside large objects are often very different from those by just the primary GCR protons in small objects. The production rates of cosmogenic nuclides are calculated to vary by about factors of 2.5 during at typical 11-year solar cycle, in agreement with measurements of short-lived radionuclides in recently fallen meteorites. The production of cosmogenic nuclides by the GCR particles outside the heliosphere is higher than that by the modulated GCR primaries normally in the solar system. However, there is considerable uncertainty in the fluxes of interstellar protons and, therefore, in the production rates of cosmogenic nuclides in interstellar space. Production rates and ratios for cosmogenic nuclides would be able to identify particles that were small in space or that were exposed to an unmodulated spectrum of GCR particles. 25 refs., 2 figs., 2 tabs.

35015 **(PB—86-143245/XAB) Solar-Geophysical Data Number 494, October 1985. Part 1 (prompt reports). Data for September 1985, August 1985, and late data.** Coffey, H.E. (National Geophysical Data Center, Boulder, CO (USA)). Oct 1985. 88p. (SGD—494-PT-1). NTIS, PC A05/MF A01.

Contents include: Detailed index for 1985; Data for September 1985 (IUWDS alert periods (advance and worldwide); Solar activity indices; Solar flares; Solar radio emission; Stanford mean solar magnetic field); (Solar active regions, Sudden ionospheric disturbances, Solar radio spectral observations, Cosmic-ray measurements by neutron monitor, Geomagnetic indices, Radio propagation indices); (Solar radio emission August 1985, Inferred interplanetary magnetic field polarity, Geomagnetic indices, Preliminary solar proton event list, Calcium plage data).

35016 **(PB—86-143252/XAB) Solar-Geophysical Data Number 494, October 1985. Part 2 (comprehensive reports). Data for April 1985, January-June 1984, and miscellanea.** Coffey, H.E. (National Geophysical Data Center, Boulder, CO (USA)). Oct 1985. 170p. (SGD—494-PT-2). NTIS, PC A08/MF A01.

Contents include: Detailed index for 1985; Data for April 1985 (Meudon carte synoptique, Solar radio bursts at fixed frequencies, Solar x-ray radiation from GOES satellite, Mass ejections from the sun, Active prominences and filaments); Data for January - June 1984--(Solar flares January 1984, Solar flares February 1984, Solar flares March 1984, Solar flares April 1984, Solar flares May 1984, Solar flares June 1984, Number of flares August 1966 - June 1984); Miscellaneous data--(Interplanetary solar wind July 1984-March 1985, Errata--Solar x-rays event list January 1985).

35017 **(PB—86-156866/XAB) Solar-Geophysical Data Number 496, December 1985. Part 1 (Prompt Reports). Data for November 1985, October 1985, and late data.** Coffey, H.E. (National Geophysical Data Center, Boulder, CO (USA)). May 1985. 105p. (SGD—496-PT-1). NTIS, PC A06/MF A01.

Contents include: Detailed index for 1985; Data for November 1985; IUWDS alert periods (Advance and worldwide), Solar-activity indices, Solar flares, Solar radio emission, VOSTOK inferred interplanetary magnetic field polarity, Stanford mean solar magnetic field); Solar-active regions, Sudden ionospheric disturbances, Solar radio spectral observations, Cosmic-ray measurements by neutron monitor, Geomagnetic indices, Radio propagation indices); Late data-(Geomagnetic indices, Solar radio spectral observations, Calcium plage data).

35018 **(PB—86-156874/XAB) Solar-Geophysical Data Number 496, December 1985. Part 2 (Comprehensive Reports). Data for June 1985, January-May 1985, and miscellanea.** Coffey, H.E. (National Geophysical Data Center, Boulder, CO (USA)). Dec 1985. 68p. (SGD—496-PT-2). NTIS, PC A04/MF A01.

Contents include: Detailed index for 1985; Data for June 1985 (Solar flares, Solar radio bursts at fixed frequencies, Solar x-ray radiation from GOES satellite graphs, Mass ejections from the sun, Active prominences and filaments); Data for January-May 1985 (Solar flares January 1985, Solar flares February 1985, Solar flares March 1985, Solar flares April 1985, Solar flares May 1985, Number of flares August 1966-June 1985); International geophysical calendar 1986.

35019 **Cold dark matter candidates and the solar neutrino problem.** Krauss, L.M.; Freese, K.; Spergel, D.N.; Press, W.H. (Lyman Laboratory of Physics, Harvard University; Harvard-Smithsonian Center for Astrophysics). *Astrophysical Journal;* **299**: No. 2, 1001-1006(15 Dec 1985).

Certain currently proposed weakly interacting elementary particles can have a high probability of solar capture if they make up the Galactic halo. Their present abundance in the Sun is here determined by balancing capture rates against annihilation rates. Both particle physics and cosmological considerations impose constraints on scattering and annihilation cross sections. In general, for the candidate particles here discussed (massive neutrinos, supersymmetric scalar neutrinos, and photinos), the inferred solar abundances are too small by three to four orders of magnitude to solve the solar neutrino problem. Extreme fine tuning, marginally possible in the case of the photino, could increase solar abundances to a level where the neutrino signature would be affected. Otherwise, either a particle with a net cosmological asymmetry, or else a new mechanism for strengthening the existing Majorana suppression of s-wave annihilation at very low energies, would seem to be required.

35020 **Secular stability of rotating stars.** Imamura, J.N.; Friedman, J.L.; Durisen, R.H. (Los Alamos National Lab., NM). pp 191-197 of Birth and evolution of neutron stars: issues raised by millisecond pulsars. Reynolds, S.P.; Stinebring, D.R. (eds.). Green Bank, WV; National Radio Astronomy Observatory (1984). (CONF-8406151—).

From Workshop on the millisecond pulsar; Green Bank, WV, USA (6 Jun 1984).

In this work, the authors calculate the secular stability limits of rotating polytropes to nonaxisymmetric perturbations of low m. Polytropic indices ranging from 1 to 3 and several angular momentum distributions are considered. Results are most conveniently presented in terms of the t-parameter, defined as the ratio of the rotational kinetic energy to the absolute value of the gravitational energy of the fluid. Previous work on polytropes considered only the m = 2 mode, which is unstable for values of the t-parameter greater than 0.14 +- 0.01 for the n values n = 1.5 and 3 and the angular momentum distributions tested (see Durisen and Imamura 1981). The GRR secular stability limit of the m - 2 mode for the Maclaurin spheroids (n = 0) was determined by Chandrasekhar (1970). GRR stability limits of higher m modes for the Maclaurin spheroids were located approximately by Comins (1979a,b) and more precisely by Friedman (1983). 16 references, 2 tables.

6402 Atmospheric Physics

REFER ALSO TO CITATION(S) 35015, 35017, 35018, 35220

35021 **(AD-A—163458/3/XAB) Plasma waves associated with the AMPTE (active magnetospheric particle tracer explorers) artificial comet.** Gurnett, D.A.; Anderson, R.R.; Haeusler, B.; Haerendel, G.; Bauer, O.H. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). Dec 1985. 6p. NTIS, PC A02/MF A01.

Numerous plasma wave effects were detected by the AMPTE/IRM spacecraft during the artificial comet experiment on December 27, 1984. As the barium ion cloud produced by the explosion expanded over the spacecraft, emissions at the electron plasma frequency and ion plasma frequency provided a determination of the local electron density. The electron density in the diamagnetic cavity produced by the ion cloud reached a peak somewhat > 500000/cc, then decayed smoothly as the cloud expanded, varying approximately as i/t-square. As the cloud began to move due to interactions with the solar wind, a region of compressed plasma was encountered on the upstream side of the diamagnetic cavity. The peak electron density in the compression region was about 15000/cc. Later, a very intense (140 mVolt/m) broadband burst of electrostatic noise was encountered on the sunward side of the compression region. This noise has characteristics very similar to noise observed in the earth's bow shock, and is believed to be a shock-like interaction produced by an ion beam-plasma instability between the nearly stationary barium ions and the streaming solar wind protons.

35022 **(AD-A—163499/7/XAB) Three-dimensional plasma observations near the outer magnetospheric boundary. Progress report.** Eastman, T.E.; Popielawska, B.; Frank, L.A. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). 1 Oct 1985. 24p. NTIS, PC A02/MF A01.

Detailed analyses of 18 ISEE 1 magnetopause crossings have been made using three-dimensional plasma data obtained by LEPEDEA's which detect ions and electrons from 1 eV to 45 keV. Crossings were examined that occurred on both the dawn and dusk flanks near sunward, outer magnetospheric boundary. Nearly all cases show a de-energization of magnetosheath plasma after this plasma crosses the magnetopause to produce the magnetospheric boundary layer. The bulk plasma flow frequently changes direction as it crosses the magetopause, resulting in boundary layer flow that has an enhanced cross-field flow component without, typically, any increase in speed. These observed flow directions are consistent with E sub p x B drifts imposed by polarization fields E sub p established near the forward extent of penetrating magnetosheath irregularities which are producing the boundary layer. Our three-dimensional observations of plasma flow demonstrate that these polarization fields are present and significant.

35023 **(AD-A—163500/2/XAB) Boundary layers as the primary transport regions of the earth's magnetotail. Progress report.** Eastman, T.E.; Frank, L.A.; Huang, C.Y. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). 1 Oct 1985. 26p. NTIS, PC A03/MF A01.

A comprehensive survey of ISEE and IMP LEPEDEA plasma measurements in the earth's magnetotail reveals that the magnetospheric boundary layer and the plasma sheet boundary layer are the primary transport regions there. These plasma measurements also distinguish various components of the plasma sheet, including the central plasma sheet and plasma sheet boundary layer. A significant new result reported here is the existence of cold-and hot-plasma components that are spatially copresent within the central plasma sheet. Such plasma components cannot be explained merely by temporal variations in spectra involving the entire plasma sheet. Contributions to a low-temperature component of the plasma sheet enter directly from the boundary layer located along the magnetotail flanks. Field-aligned flows predominate within the plasma sheet boundary layer, which is almost always present and is located near the northern and southern border of the plasma sheet. The plasma sheet boundary layer comprises highly anisotropic ion distributions, including countersteaming ion beams, that evolve into the hot, isotropic component of the plasma sheet. Tailward acceleration regions generate these ion beams with plasma input from the magnetospheric boundary layer. Antisunward flowing ion beams are frequently observed in the plasma sheet boundary layer and in the tail lobes.

35024 **(AD-A—163654/7/XAB) Plasma observations in the auroral and polar-cap region. Technical report.** Fennell, J.F. (Aerospace Corp., El Segundo, CA (USA). Space Sciences Lab.). 15 Dec 1985. 37p. (TR—0086(6940-05)-12). NTIS, PC A03/MF A01.

The last decade has seen a period of rapid growth in our understanding of the processes that occur in the auroral regions. Much of our understanding is based on the copious new observations that have been made available in the auroral community. The present work is a short overview of the plasma conditions that obtain throughout much of the auroral region. It covers the diffuse and discrete auroral electron precipitation in the morning and evening oval, cusp, and polar cap. The ionospheric ion outflow throughout the high latitude regime is also discribed and related to the electron observations.

35025 **(AD-A—163716/4/XAB) Electron precipitation patterns in the vicinity of a vlf transmitter. Technical report.** Vampola, A.L. (Aerospace Corp., El Segundo, CA (USA). Space Sciences Lab.). 15 Dec 1985. 25p. (TR—0086(6940-05)-2). NTIS, PC A02/MF A01.

Using high-resolution pitch-angle measurements made by a magnetic-focusing electron spectrometer on the S3-3 satellite, angular distributions of 235-keV electrons precipitated by a ground-based VLF transmitter are compared with the pitch-angle distributions that would be produced by various patterns of longitudinal interaction regions. The observed electrons are in the drift loss cone, necessitating the use of a trace-back-to-longitude-of-origin technique coupled with a two-dimensional convolution program describing the response of the electron spectrometer. The data are well-fit with both theoretical calculations of ionospheric field intensity patterns above a transmitter and with a similar pattern of received field intensities measured along a traverse in the conjugate region. The agreement between the data and field patterns implies a linear or quasi-linear wave-particle interaction. The energy-frequency relationship between the electrons and the waves implies an interaction region low on the magnetic field line, perhaps near or at the unperturbed mirror point.

35026 **(AD-A—163835/2/XAB) Statistical analysis of low-energy electrons and their relationship to radiowave scintillations. Master's thesis.** Ober, W.E. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Dec 1984. 165p. NTIS, PC A08/MF A01.

The relationship between the observed increase in the flux of low-energy (500 eV) electrons, at an altitude of 800 km and the corresponding amplitude and frequency scintillations of radio

waves passing through ionospheric irregularities at 350 km was studied. These data were measured by the electron spectrometer (J-sensor), the magnetometer, and the radio beacon experiment (137 MHz and 413 MHz) of the HILAT satellite. The data analyzed here were taken from January-March 1984. During that time interval, 198 enhancements of electron flux were recorded in the night sensors (magnetic local time), occurring most frequently at 0300 and 2300 MLT. For 73 of these enhancements, magnetometer data was examined for corresponding geomagnetic disturbances, but only nine had such associated disturbances.

35027 **(AD-A—164066/3/XAB) Effect of the interplanetary magnetic field Y component on the high-latitude nightside convection.** La Beaujardiere, O.; Wickwar, V.B.; Kelly, J.D.; King, J.H. (SRI International, Menlo Park, CA (USA)). Jul 1985. 5p. NTIS, PC A02/MF A01.

Sondrestrom radar observations reveal that the dawn-dusk (By) component of the interplanetary magnetic field (IMF) strongly influence the nightside polar convection. This effect is quite complex. The convection for one orientation of By is not the mirror image of the other orientation. A positive By (i.e., pointing toward dusk) seems to organize the velocities such that, at all local times, they are predominantly westward within the radar field-of-view (approx. 68 deg -to-82 deg invariant latitude). Between dusk and midnight, on one such occasion, sunward flow is observed within the polar cap. In the midnight and dawn sectors, when By is negative, the plasma velocities often appear random. For large negative By, the afternoon cell appears shifted toward early hours such that large southward velocities are observed about 3 hours before midnight. These are the only times when the predominant velocity component is southward.

35028 **(AD-A—164090/3/XAB) Some properties of the auroral thermosphere inferred from initial EISCAT (European Incoherent Scatter Facility) observations.** Alcayde, D.; Fontanari, J.; Bauer, P.; la Beaujardiere, O. (SRI International, Menlo Park, CA (USA)). Dec 1983. 7p. NTIS, PC A02/MF A01.

Using the equation of ion energy conservation, preliminary calculations of thermosphere neutral-temperature profiles and atomic oxygen concentrations are made for 2 days of EISCAT incoherent scatter radar data. Since the original method currently applied at mid-latitudes is not valid when joule heating of the ions occurs, the author extended it to take joule heating into consideration. However, this new method is not valid if joule heating occurs simultaneously with electron heating by particle precipitation or photoelectrons. It is shown show that the electron continuity equation around 200 km altitude can be applied to identify the periods of particle precipitation.

35029 **(AD-A—164222/2/XAB) Early MITHRAS results: the electric field response to substorms.** Beaujardiere, O.; Holt, J.; Nielsen, E. (SRI International, Menlo Park, CA (USA)). Dec 1983. 8p. NTIS, PC A02/MF A01.

The MITHRAS data base offers a unique opportunity to observe simultaneously the auroral-zone ion-convection pattern with three radars, widely separated in longitude. The authors attempt to separate local-time versus universal-time effects in a study of the electric field signature associated with substorms. Preliminary results indicate that this signature is similar at a given local time, regardless of the longitude of the station. In the dawn and dusk sectors the electric field is intensified, whereas around noon and midnight the electric field appears to reverse during a substorm. The potential drop across the polar cap can be estimated from the potential across the auroral oval. The radar agree well with the relationship found by Reiff and co-workers between the solar wind energy parameter epsilon and the cross-tail potential.

35030 **(AD-A—164315/4/XAB) Observations of gravity waves in the auroral zone.** Bertin, F.; Kofman, W.; Lejeune, G. (SRI International, Menlo Park, CA (USA)). Dec 1983. 8p. NTIS, PC A02/MF A01.

The electron density, ion temperature, and velocity measured on November 18, 1981, from 1100 to 1700 UT by EISCAT facilities exhibited clearly periodic behavior. The authors present an attempt to interpret this feature as a manifestation of gravity waves. November 18 was a day of high magnetic activity, and it was difficult to separate completely the local effects from those induced by the gravity waves. The observed waves had a period of about 75-80 min and vertical wavelength of the order of 800 km. They were possibly generated in the auroral oval, about 1000 km from Tromo.

35031 **(AD-A—164460/8/XAB) Research in solar-terrestrial physics. Final technical report, 1 October 1981-30 November 1983.** (California Univ., Los Angeles (USA)). 25 Jan 1986. 15p. NTIS, PC A02/MF A01.

Contents include: ultra-low-frequency waves; magnetic pulsations; predicting geomagnetic activity using solar wind data; auroral electrojets; partial ring current; the symmetric ring current; the role of driven and unloading processes in substorms; a study of the near-earth plasma sheet; and methods of time-series data base management.

35032 **(AD-A—164502/7/XAB) Implementation of an ionospheric-image file management, processing, and display system. Final report, 1 September 1981-28 February 1985.** Lucas, R.D.; Robins, R.E. (Physical Dynamics, Inc., Bellevue, WA (USA)). 15 Apr 1985. 38p. (PD-NW—85-331R). NTIS, PC A03/MF A01.

This Phase I SBIR project addressed the problem of processing the All-Sky Imaging Photometer (ASIP) images collected in support of ionospheric science programs at AFGL and elsewhere. Hardware and software tools are developed that efficiently transform any image of interest to suitable world coordinates, thus removing the geometric distortions introduced by the ASIP wide-angle lens. Interactive graphical tools are demonstrated for the composite display of multiple, concurrent ASIP images, in geometrically corrected form, with a variety of correlative data from other sensor systems. Such systems might include incoherent-scatter radar, the HILAT satellite, and others. Eighteen black and white photographs are presented showing examples of actual ASIP images and test patterns in both raw and geometrically corrected form. Results demonstrating the resolution requirements of the ASIP data are included. Various aspects of the geometrical transformation and image-enhancement processing are illustrated, and example composite displays with actual ASIP and HILAT data are presented. Phase I focused on determining (1) the resolution, sensitivity, and accuracy required to capture digitally the information present in the ASIP imagery and (2) the size of computational problem involved in the required image transformations. The authors conclude that a properly integrated workstation involving both analog and digital video and microcomputer-based graphical components will provide a powerful and cost-effective solution to the problem posed by the ASIP data base.

35033 **(AD-A—164504/3/XAB) Research in solar-terrestrial physics. Final technical report, 1 December 1983-31 March 1985.** McPherron, R.L. (California Univ., Los Angeles (USA)). 25 Jan 1986. 35p. NTIS, PC A03/MF A01.

The primary goal of the research is to understand the physical phenomena that transfer energy from the solar wind to the magnetosphere, which dissipole this transport energy within the magnetosphere, and finally which lead to its dissipation in the ionosphere and its return to the solar wind. The research projects include three distinct topics: solar wind-magnetosphere coupling, triggering of substorm expansion onsets, and generation of ultra-low-frequency waves. Investigation of solar wind-magnetosphere coupling is concerned with establishing how the rate of energy transfer into the magnetosphere depends on bulk parameters of the solar wind. The second topic, triggering of substorm onsets, is concerned with understanding the mechanism whereby solar wind energy stored in the tail lobes is released into the inner magnetoshere. In the model favored, this release is caused by reconnection of lobe magnetic field at a near-earth neutral line. The research is concerned with demonstrating that this process is highly localized, transient, and at times involves multiple neutral lines. The third topic is the study of ultra-low-frequency waves (ULF) (1-1000 mHz).

35034 **(PB—86-153608/XAB) Generation of auroral arcs and inverted-V structures.** Stasiewicz, K. (Kiruna Geophysical Inst. (Sweden)). Oct 1985. 70p. (KGI—191). NTIS, PC A04/MF A01.

This study combines an analysis of a large amount of electron energy spectra (<30 keV) measured by satellite instrumentation with theoretical considerations based on quasilinear kinetic and magnetohydrodynamic equations. This has made it possible to provide explanations of some important problems in auroral electrodynamics. An explanation is given for the physical mechanism which leads to the formation of thin and multiple auroral arcs. The proposed mechanism is derived from laboratory plasma experiments and is consistent with both optical and in situ measurements. Auroral arcs and inverted-V structures in electron precipitation are related to plasma pressure inhomogeneities (clouds) in the magnetosphere. It is shown that the process of homogenization of magnetospheric plasma structures leads to the generation of electric potential structures which accelerate earthward the electrons producing discrete aurora.

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REFER ALSO TO CITATION(S) 34376, 34457, 34710, 35190, 35217, 35217

35035 **(AD-A—163847/7/XAB) Inhibited spontaneous emission by a Rydberg atom.** Hulet, R.G.; Hilfer, E.S. (Massachusetts Inst. of Tech., Cambridge (USA). Research Lab. of Electronics). 11 Nov 1985. 6p. NTIS, PC A02/MF A01.

Spontaneous radiation by an atom in a Rydberg state is inhibited by use of parallel conducting planes to eliminate the vacuum modes at the transition frequency. Spontaneous radiation emission is observed to turn off abruptly at the cutoff frequency of the waveguidelike structure, and the natural lifetime is measured to increase by a factor of at least 20.

35036 **(AD-A—163954/1/XAB) Laser cooling of neutral atoms. Master's thesis.** McHarg, M.G. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Dec 1983. 116p. (AFIT/GEP/PH—83D-6). NTIS, PC A06/MF A01.

The theory of the resonance radiation force is studied as it applies to the slowing of a two-level atom using a swept-frequency laser. The theory is developed in detail for this case. A single partial differential equation, the Fokker-Planck equation, is found to describe the atomic motion for many cases. This equation is solved numerically for a one-dimensional geometry. Results from this numerical solution are found to be within 10% of experimental results. Analysis of this problem in one dimension leads to the prediction that for fixed amounts of frequency sweeping, a faster scan rate will yield smaller full width at half maximum (FWHM) spread in the velocity distribution for the atomic beam. This program also predicts that the atoms can be slowed arbitrarily close to 0 m/sec using this technique. The program used for this analysis is included.

35037 **(CEA-CONF—8203) Relativistic calculations for many electron atoms.** Desclaux, J.P. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). May 1985. 14p. (CONF-8505189—6). NTIS (US Sales Only), PC A02/MF A01. File Number DE86751873.

From Atomic theory workshop on relativistic and QED effects in heavy atoms; Gaithersburg, MD, USA (23 May 1985).

Many improvements have now been introduced in ab-initio methods for relativistic atomic structure calculations. After a short description of the different methods, we review the various contributions to energy levels and compare the most recent theoretical and experimental results for few electron heavy ions.

35038 (DOE/ER/01067—24, pp 140-154) **Research summary: experiments which use the X-ray charge changed beam apparatus and equipment development.** Shafroth, S.M.; Clark, M.W.; Swenson, J.K.; Anthony, J.M.; Reed, M. 1985. NTIS, PC A10/MF A01. File Number DE86003851.

In Triangle Universities Nuclear Laboratory annual report - TUNL XXIV, 1 July 1984-31 August 1985.

Several atomic physics experiments are briefly described. These include resonant and nonresonant transfer excitation, simultaneous excitation and ionization, bare H-like and He-like beam experiments and single and double electron capture. Equipment development is also discussed.

35039 **(DOE/ER/10979—12) Nonlinear optics with broad-band lasers. Progress report, July 15, 1985-July 1986.** Raymer, M.G. (Rochester Univ., NY (USA). Inst. of Optics). Mar 1986. Contract AC02-81ER10979. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86011286.

Progress has been made in the studies of both stimulated Raman scattering (SRS) with pulsed broad-band lasers and the statistical behavior of multimode cw dye lasers. It has been observed that in pumping SRS by a broad-band dye laser intensity fluctuations in the pump laser are transferred to some extent to the generated Stokes light. The intensity cross-correlation function between the pump and Stokes were directly measured and its form was found to be influenced by the medium's relaxation time. The statistical properties of a cw dye laser are being studied by observing its intensity autocorrelation function and corresponding power spectrum. 5 refs., 2 figs.

35040 **(DOE/ER/13332—1) Spectroscopic studies of hydrogen atom and molecule collisions. Progress report, January 16, 1985-January 15, 1986.** Kielkopf, J. (Louisville Univ., KY (USA). Dept. of Physics). 7 Apr 1986. Contract FG05-85ER13332. 4p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86010915.

Hydrogen atom and molecule interactions, and the energetics and dynamics of molecular hydrogen collisions using both conventional dispersive and laser-spectroscopic methods are discussed. The experiments may be divided broadly into three categories: the impact broadening of atomic hydrogen line cores; the wings of the atomic lines; and excitation transfer in the molecule.

35041 **(DOE/ER/13405—1) Multiphoton interactions in molecules with picosecond laser pulses. Progress report, July 15, 1985-July 14, 1986.** Kwok, H.S. (State Univ. of New York, Buffalo (USA). Dept. of Electrical and Computer Engineering). 10 Jan 1986. Contract FG02-85ER13405. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86011550.

The phenomena of superexcitation is discussed for C_2F_5Cl. This phenomena, which was first observed for SF_6, is the excitation of very high levels of molecules by ultrashort pulses. For the same fluence, picosecond pulses were found to deposit more energy into the molecule than longer duration pulses. A second experimental result is discussed. The effect of collisions and pulse duration on the absorption spectrum of C_3F_7I. In this experiment it is observed that the linewidth decreases with pulse length. A red shift is observed with increased pressure. 2 refs., 2 figs.

35042 **(DOE/PR/06010—T35) Electron-atom collision studies using optically state selected beams. Progress report, 1 May 1985-30 April 1986.** Celotta, R.J.; Kelley, M.H. (National Bureau of Standards, Washington, DC (USA). Center for Radiation Research). 1 Jan 1986. Contract AI01-76PR06010. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86009349.

Collisions studies using optically state selected beams is discussed. Measurements of spin resolved differential cross sections for superelastic scattering of electrons from excited sodium atoms (3P) are reported. The excited states are prepared by laser optical pumping with circularly polarized light thus giving a pure atomic state before the collision. A crossed beam arrangement of sodium atoms and electrons is used with a scattered electron detector. Scattered electron intensity as a function of scattering angle, incident electron energy, and relative orientation of the incident electronic and atomic spins is measured. 8 refs., 10 figs.

35043 (GSI—86-1-Prepr.) Non-perturbative treatment of excitation and ionization in U^{92+}/U^{91+} collisions at 1 GeV/amu. Becker, U.; Gruen, N.; Scheid, W.; Soff, G. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Giessen Univ. (Germany, F.R.). Inst. fuer Theoretische Physik). Jan 1986. 12p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86752034.

Inner shell excitation and ionization processes in relativistic collisions of very heavy ions are treated by a non-perturbative method for the first time. The time-dependent Dirac equation is solved by a finite difference method for the scattering of U^{92+} on U^{91+} at Esub(lab) = 1 GeV/amu and zero impact parameter. The K-shell ionization probabilities are compared with those resulting from first-order perturbation theory. (orig.).

35044 (LA—10726-T) Response of the $^1P^0$ resonance near n = 3 in the H^- continuum to external electric fields. Cohen, S. (Los Alamos National Lab., NM (USA)). May 1986. Contract W-7405-ENG-36. 115p. NTIS, PC A06. File Number DE86011739.

The response to external electric fields of the $^1P^0$ resonance in the H^- photodetachment continuum below the n = 3 hydrogenic excitation threshold is investigated. Using the relativistic (β = 0.806) 650 MeV H^- beam at the Clinton P. Anderson Meson Physics Facility (LAMPF) in Los Alamos, the fourth harmonic (2.66 nm) of a Nd:YAG laser is Doppler shifted to provide a continuously tunable photon beam in the rest frame of the ions. The magnetic field from pulsed Helmholtz coils, surrounding the photon-H^- interaction point provides a Lorentz-transformed barycentric electric field. Relative total photodetachment cross sections were measured as a function of photon energy and electric field. The resulting spectra were fit to a Fano line shape. 70 refs., 28 figs., 7 tabs.

35045 (LA-UR—86-1574) Neutron-induced gamma-ray spectroscopy: simulations for chemical mapping of planetary surfaces. Brueckner, J.; Waenke, H.; Reedy, R.C. (Los Alamos National Lab., NM (USA); Max-Planck-Institut fuer Chemie (Otto-Hahn-Institut), Mainz (Germany, F.R.)). 1986. Contract W-7405-ENG-36. 66p. (CONF-860375—3). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86011261.

From Lunar and planetary science conference; Houston, TX, USA (17 Mar 1986).

Cosmic rays interact with the surface of a planetary body and produce a cascade of secondary particles, such as neutrons. Neutron-induced scattering and capture reactions play an important role in the production of discrete gamma-ray lines that can be measured by a gamma-ray spectrometer on board of an orbiting spacecraft. These data can be used to determine the concentration of many elements in the surface of a planetary body, which provides clues to its bulk composition and in turn to its origin and evolution. To investigate the gamma rays made by neutron interactions, thin targets were irradiated with neutrons having energies from 14 MeV to 0.025 eV. By means of foil activation technique the ratio of epithermal to thermal neutrons was determined to be similar to that in the Moon. Gamma rays emitted by the targets and the surrounding material were detected by a high-resolution germanium detector in the energy range of 0.1 to 8 MeV. Most of the gamma-ray lines that are expected to be used for planetary gamma-ray spectroscopy were found in the recorded spectra and the principal lines in these spectra are presented. 58 refs., 7 figs., 9 tabs.

35046 (SAND—86-0258C) Experimental verification of non-equilibrated bremsstrahlung dosimetry predictions for 0.75 MeV electrons. Sanford, T.W.L.; Halbleib, J.A.; Beezhold, W.; Lorence, L.J. (Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 5p. (CONF-860706—7). NTIS, PC A02/MF A01; GPO Dep. File Number DE86006466.

From 23. annual conference on nuclear and space radiation effects; Providence, RI, USA (20 Jul 1986).

A set of experiments was carried out to test the ITS, the Integrated TIGER Series of coupled electron/photon Monte Carlo transport codes, for electron energies typical of those used in x-ray simulators. A beam of 0.75 MeV electrons was incident on a bremsstrahlung converter. Two converters were used, one to generate a soft x-ray spectrum with mean photon energy of 85 keV and the second a harder spectrum of mean energy 145 keV. The bremsstrahlung radiation was measured by thermoluminescent dosimeters encapsulated with varying amounts of Ta and Al. The experimental results verify the modeling of the code. 4 refs., 3 figs. (WRF)

35047 (UCID—20744) Atomic physics and non-equilibrium plasmas. Weisheit, J.C. (Lawrence Livermore National Lab., CA (USA)). 25 Apr 1986. Contract W-7405-ENG-48. 74p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86010780.

Three lectures comprise the report. The lecture, Atomic Structure, is primarily theoretical and covers four topics: (1) Non-relativistic one-electron atom, (2) Relativistic one-electron atom, (3) Non-relativistic many-electron atom, and (4) Relativistic many-electron atom. The lecture, Radiative and Collisional Transitions, considers the problem of transitions between atomic states caused by interactions with radiation or other particles. The lecture, Ionization Balance: Spectral Line Shapes, discusses collisional and radiative transitions when ionization and recombination processes are included. 24 figs., 11 tabs.

35048 K-shell ionization in 7.5- and 8.6-MeV/a.m.u. U + U collisions at very small impact parameters. Molitoris, J.D.; Stoller, C.; Anholt, R.; Meyerhof, W.E.; Spooner, D.W.; McDonald, R.J.; Sobotka, L.G.; Wozniak, G.J.; Moretto, L.G.; McMahan, M.A. (Stanford Univ., CA, USA. Dept. of Physics; Lawrence Berkeley Lab., CA, USA. Nuclear Science Div.). *Zeitschrift fuer Physik D: Atoms, Molecules and Clusters;* 2: No. 2, 91-98(Jun 1986). Contract AC03-76SF00098.

K-vacancy production probabilities in elastic 7.5- and 8.6-MeV/a.m.u. U + U collisions are reported for impact parameters less than 15 fm. In 7.5-MeV/a.m.u. U + U collisions the ionization probability rise above the trend indicated by larger impact parameter measurements, increasing to 1.8 vacancies per collision at the smallest impact parameter. The measured probabilities for 8.6-MeV/a.m.u. collisions increase to a maximum value of slightly less than 2 vacancies per collision at the smallest impact parameters. The data is compared to previous results and existing theory.

35049 Heat-pipe-oven molecular-beam source. Drullinger, R.E. (to Dept. of Commerce, Washington, DC). US Patent Application 6-802,875. 29 Nov 1985. 21p. NTIS, PC A02/MF A01.

An atomic beam source or molecular beam source constructed in accordance with this invention comprises a porous wicking oven substrate (which as used herein means the body of the oven). The oven is heated so as to maintain a temperature gradient between the orifice and a portion of the substrate remote from the orifice so as to create a source region for providing evaporated working material molecules in line of sight with the orifice, and a collimating region including at least a portion of the cavity for collimating the evaporated working material molecules to form the molecular beam and for recirculating working material condensate to the source region of the substrate.

35050 New experiments on few-electron very heavy atoms. Gould, H. (Lawrence Berkeley Lab., CA). *AIP (American Institute of Physics) Conference Proceedings;* No. 136, 66-79(1985). (CONF-8505189—). Contract AC03-76SF00098.

From Atomic theory workshop on relativistic and QED effects in heavy atoms; Gaithersburg, MD, USA (23 May 1985).

New experiments, to test quantum electrodynamics (QED) in strong Coulomb fields and to study atomic collisions at ultra relativistic energies, are proposed. A 0.1% measurement of the 2 ^{3}P/sub 1/2/ - 2 ^{3}S/sub 1/2/ splitting in lithium-like uranium (Z = 92) and the 2 $^3P_0$ - 2 $^3S_1$ splitting in helium-like uranium is proposed as a sub 1% test of the Lamb shift in a strong Coulomb field. Measurements of the hyperfine splitting of hydrogenlike thallium (Z = 81) and the g/sub j/ factor of the ground state of hydrogenlike uranium are proposed as a test of the QED contribution to the magnetic moment of an electron bound in a strong Coulomb field. Measurements of capture cross sections for ultrarelativistic very heavy

nuclei are proposed to look for the capture of electrons from pair production.

35051 **Recent wavelength measurements in 2- and 3- electron systems - a brief report.** Berry, H.G. (Argonne National Lab., IL). *AIP (American Institute of Physics) Conference Proceedings;* No. 136, 94-99(1985). (CONF-8505189—). Contract W-31-109-ENG-38.

From Atomic theory workshop on relativistic and QED effects in heavy atoms; Gaithersburg, MD, USA (23 May 1985).

Presented 3 are recent precision measurements of the ls2s ^{3}S - ls2p ^{3}P wavelengths in the helium-like, two-electron systems Li II, Ne IX and Ti XXI. We also comment on an old (1981) comparison between theory and experiment for the ls^{2}2s ^{2}S - ls^{2}2p ^{2}P transition wavelengths in the lithium-like, three electron isoelectronic sequence.

35052 **Pair production at GeV/u energies.** Bottcher, C.; Strayer, M.R. (Oak Ridge National Lab., TN). *AIP (American Institute of Physics) Conference Proceedings;* No. 136, 268-298(1985). (CONF-8505189—). Contract AC05-84OR21400.

From Atomic theory workshop on relativistic and QED effects in heavy atoms; Gaithersburg, MD, USA (23 May 1985).

Electron and positron production in relativistic ion-atom collisions is discussed within the context of the time-dependent Dirac-Hartree approximation to a fully relativistic field theory of the collision. The time-dependent fields are treated classically, and the numerical methods employing basis splines are discussed in detail and contrasted with results obtained from the case of non-relativistic velocities. The results of a one-dimensional model are presented and show a moderately large probability for pair production followed by electron capture.

35053 **Theory of K/sup n/L/sup nu/ multiple vacancy production by heavy ions.** Becker, R.L.; Ford, A.L.; Reading, J.F. (Oak Ridge National Lab., TN). *Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms;* **B10/11**: 1-6(1985). (CONF-841117—Pt.1). Contract AC05-84OR21400.

From 8. conference on the application of accelerators in research and industry; Denton, TX, USA (12 Nov 1984).

Observation of intensities of K/sub γ/ X-ray or Auger satellites and hypersatellites together with fluorescence yields provides knowledge of KL/sup nu/ and K^{2}L/sup nu/ vacancy distributions produced by ion-atom collisions. The traditional theory used since about 1972 employs a single-particle model and a weak-coupling ionization approximation. The authors reviewed their recent extensions of the theory to include Pauli correlations in the independent-Fermi-particle model, a unitary collision theory in the first Magnus and coupled-channels approximations, electron transfer to the projectile, and contributions from shake-off which interfere with the collision-induced amplitudes.

35054 **Resonant-transfer-and-excitation for highly charged ions ($16 \leqq Z \leqq 23$) in collisions with helium.** Tanis, J.A.; Bernstein, E.M.; Oglesby, C.S.; Graham, W.G.; Clark, M.; McFarland, R.H.; Morgan, T.J.; Stockli, M.P.; Berkner, K.H.; Schlachter, A.S.; Stearns, J.W. (Western Michigan Univ., Kalamazoo). *Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms;* **B10/11**: 128-133(1985). (CONF-841117—Pt.1). Contract AC02-83ER13116.

From 8. conference on the application of accelerators in research and industry; Denton, TX, USA (12 Nov 1984).

Significant new evidence is presented for resonant-transfer-and-excitation (RTE) in ion-atom collisions. This process occurs when a target electron is captured simultaneously with the excitation of the projectile followed by deexcitation via photon emission. RTE, which is analogous to dielectronic recombination (DR), proceeds via the inverse of an Auger transition, and is expected to be resonant for projectile velocities corresponding to the energy of the ejected electron in the Auger process. RTE was investigated by measuring cross sections for projectile K X-ray emission coincident with single electron capture for 15-200 MeV $_{16}S^{12+}$, 100-360 MeV $_{20}$Ca/sup 16+,17+,18+/ and 180-460 MeV $_{23}$V/sup 19+,20+,21+/ ions colliding with helium. Strong resonant behavior, in agreement with theoretical calculations of RTE, was observed in the coincidence cross sections.

35055 **Terminal distributions of rotational energy in free jets of CO_2 by infrared emission spectrometry.** Venkateshan, S.P.; Ryali, S.B.; Fenn, J.B. (Yale Univ., New Haven, CT). *Journal of Chemical Physics;* **77**: No. 5, 2599-2609(1 Sep 1982). Contract FG01-78ET11384.

By means of Fourier transform infrared spectrometry the authors have analyzed the radiation from supersonic free jets of CO_2 issuing from heated nozzle sources. The terminal rotational energy contents deduced from the spectra are consistent with those obtained by other methods. The distributions of this energy are clearly non-Boltzmann. A two-temperature model provides remarkably faithful descriptions of the observed distributions and leads to a simple characterization of the departure from rotational equilibrium in terms of a rotational entrophy. The results show that the extent of this departure increases with source density. Competition between rotation-rotation and rotation-translation exchanges seems to provide a plausible explanation for the observed behavior. 34 references, 10 figures.

35056 **(ORNL/tr—86/6) Measurement of the differential cross section by Raleigh by means of a ruby laser application.** Skowronek, M.; Vitel, Y.; Bayer, C. Translated from *Journal de Physiue (Les Ulis) ;* **34**: vp(Feb-Mar 1973). Contract AC05-84OR21400. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86009677.

The Rayleigh scattering is studied by means of a ruby laser as a function of the gas pressure, the volume, and the index of refraction. Two independent methods allow us to measure the differential cross section. The values obtained are below those of Rayleigh theory from a factor 2.2 +- 0.4. 5 refs., 6 figs., 4 tabs.

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REFER ALSO TO CITATION(S) 35212, 35213, 35387

35057 **A singular perturbation approach to non-Markovian escape rate problems.** Dygas, M.M.; Matkowsky, B.J.; Schuss, Z. (Dept. of Engineering Sciences and Applied Mathematics, Technological Inst., Northwestern Univ., Evanston, IL 60201). *SIAM Journal on Applied Mathemadics;* **46**: No. 2, vp(Apr 1986). Contract AC02-78ER04650.

The authors employ singular perturbation methods to examine the generalized Langevin equation which describes the dynamics of a Brownian particle in an arbitrary potential force field, acted on by a fluctuating force describing collisions between the Brownian particle and lighter particles comprising a thermal bath. In contrast to models in which the collisions occur instantaneously, and the dynamics are modeled by a Langevin stochastic equation, they consider the situation in which the collisions do not occur instantaneously, so that the process is no longer a Markov process and the generalized Langevin equation must be employed. They compute expressions for the mean exit time of the Brownian particle from the potential well in which it is confined.

35058 **Abstract approach to evaporation models in rarefied gas dynamics.** Greenberg, W.; van der Mee, C.V.M. (Universita degli Studi di Firenze, Italy). *Zeitschrift fuer Angewandte Mathematik und Physik;* **35**: 156-165(Mar 1984). Contract AS05-80ER10711.

Considerable effort over the past ten years has been devoted to the rigorous treatment of various specific linear transport models. The authors now have available an existence and uniqueness theory for half range boundary value problems related to the abstract equation, for T and A self-adjoint (both possibly unbounded) and A positive Fredholm. The abstract equation models numerous transport phenomena in addition to rarefied gas dynamics, including electron and phonon transport, radiative transfer, neutron transport, etc. The linear problems in gas dynamics represent, as is typical, perturbations of density from the equilibrium distribution. For that reason, the asymptotic condition (2b) was studied.

6451 Particle Interactions And Properties - Experimental

35059 (DESY—85-116) Heavy flavors in e^+e^- interactions. Eisenberg, Y. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.); Weizmann Inst. of Science, Rehovoth (Israel)). Oct 1985. 53p. NTIS (US Sales Only), PC A04/MF A01. File Number DE86752060.

Recently a considerable amount of both theoretical and experimental effort has been given to Heavy Flavor Physics, mainly since: The Q anti Q system is simple. Spectroscopy and successful calculations are possible. A good separation of the Heavy Flavors (Jets, Mesons) is possible. So, Single Flavor Jets or isolated processes can be studied in analogy to μ -> eanti νsub(e)νsub(μ) decays. Therefore: 1. We can determine the Standard-Model parameters like masses, and the K-M matrix. 2. We can check the validity of the Standard-Model by the absence of forbidden processes. 3. We can test for flavor independence required by QCD. 4. We can find possible clues for new physics, 4th generation effects, for new CP-violations in B^0 decays and others.

35060 (DESY—85-129) Search for gluinos in decays of the Xsub(b)(1^3P_1) meson. Albrecht, H.; Binder, U.; Harder, G.; Lembke-Koppitz, I.; Philipp, A.; Schmidt-Parzefall, W.; Schroeder, H.; Schulz, H.D.; Wurth, R.; Donker, J.P. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.); Dortmund Univ. (Germany, F.R.). Inst. fuer Physik; Heidelberg Univ. (Germany, F.R.). Inst. fuer Hochenergiephysik; McGill Univ., Montreal, Quebec (Canada); Carleton Univ., Ottawa, Ontario (Canada); Toronto Univ., Ontario (Canada)). Nov 1985. 14p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86752053.

Using the ARGUS detector at the DORIS II e^+e^- storage ring, we have searched for gluinos (g tilde), the supersymmetric partner of the gluon, by looking for secondary decay vertices in hadronic decays of Xsub(b)(1^3P_1) mesons. Events containing Xsub(b)(1^3P_1) states were selected by detecting the radiative transition from the Y(2S) in a data set corresponding to an integrated luminosity of 38.6 pb^{-1}. The absence of secondary vertices from gluino decays into hadrons and a photino allows us to exclude gluinos in a mass range from 1 to 4.5 GeV/c^2 and a lifetime range from 10^{-11} to 10^{-9} sec.

35061 (DESY—86-001) Determination of the B lifetime. Bartel, W.; Becker, L.; Cords, D.; Felst, R.; Heidt, D.; Knies, G.; Krehbiel, H.; Laurikainen, P.; Magnussen, N.; Meinke, R. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.); Hamburg Univ. (Germany, F.R.). 2. Inst. fuer Experimentalphysik; Heidelberg Univ. (Germany, F.R.). Physikalisches Inst.; Lancaster Univ. (UK); Manchester Univ. (UK); Maryland Univ., College Park (USA)). Jan 1986. 22p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86751736.

We have determined the lifetime of B-hadrons produced in e^+e^- annihilation into multihadronic final states, by measuring the impact parameter of the track with respect to the centre of the interaction region. Two different analyses of the data were performed and gave compatible results. the lifetime is tausub(B)=1.8sup(+0.5)+- 0.4 psec. (orig.).

35062 (IFVE-OEF—84-143) Observations of the peculiar A dependence of a production process of symmetric hadron pairs at large P. Abramov, V.V.; Baldin, B.Yu.; Buzulutskov, A.F. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1984. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE86702139.

Submitted to the jornal Phys. Lett. B. .

The effect of decreasing meson pair yields with heavy nuclei is too strong to be attributed to reveaiing the EMC effect. Value α equal to 0.52 for pion pairs at Psub(perpendicular)=2.02 GeV/c corresponds to 5 different types of nucleon yields with Be and Pb nuclei. Observed A-dependence of symmetric hadron pair production only for pairs with proton participation is within the framework of parton model representations while for meson pairs it turns out to be considerably more complex.

35063 (ITEF—24(1985)) Search for the irregularities in the momentum spectra of pions from the $\pi p C \rightarrow \pi^- X$ reaction at 1.5 GeV/c. Burgov, N.A.; Gerzon, S.A.; Kiselev, Yu.T.; Martem'yanov, A.N.; Novikov, V.L.; Semenov, S.V.; Terekhov, Yu.V.; Fedyushkina, N.A.; Chumakov, M.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1985. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE86702140.

To search for narrow irregularities the $\pi^- C \rightarrow \pi^- X$ reaction momentum spectrum at 1.5 GeV/c momentum of an incident pion has been investigated. Invariant cross sections of the pion production with 140-700 MeV/c momenta escaping from carbon nucleus at 145-125 deg angles have been measured. Approximately 10 MeV/c narrow irregularities were not discovered in the pion momentum spectrum. A broad arm related to the contribution of the quasi-elastic scattering process is separated against the background of a common decreasing spectrum.

35064 (ITEF—40(1985)) Measurement of an asymmetry of elastic pion-proton scattering at 1.4-2.1 GeV/c momenta. Budkovskij, P.E.; Dobrov, V.M.; Zhurkin, V.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1985. 26p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE86702141.

Experimental data on asymmetry in elastic scattering of negative pions on polarized protons in the range of central scattering angles at initial momenta of 1.4-2.1 GeV/c are presented. Systematic deviations of the measured asymmetry from predictions of existing phase analyses are disclosed in the 1.6-2.1 GeV/c range. The work is carried out by means of the SPIN facility at the accelerator of the Institute of Theoretical and Experimental Physics.

35065 (JINR—E-1-84-374) Cumulative effect and processes of multiple particle production. Kuznetsov, A.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1984. 18p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86702138.

Submitted to the 22. International conference on high energy physics (Leipzig, 1984).

A review is given of experimental data on a study of correlation effects and properties of hadron jets produced in cumulative hadron-nucleus interactions for momenta of 10 and 40 GeV/c. The investigation has been performed on pictures from a 2 m propane bubble chamber of the high energy Laboratory, JINR. The established regularities show evidence for the existence in nuclei multiquark states which strongly differ from nucleons in their structure. Results of studying correlation phenomena and hadron jet production in cumulative hadron-nucleus processes indicate that the fragmentation of multiquark states in light nuclei is similar to that of quarks and diquarks in "soft" and "hard" hadron collisions. In hadron interactions with light nuclei the framentation of quarks into hadron jets occurs mainly outside the nucleus.

35066 (JINR—R-1-85-259) Multiplicity correlations between secondary charged particles in the forward backward hemispheres in the c.m.s. from πp interactions at 40 GeV/c. Grishin, V.G.; Didenko, L.A.; Kuznetsov, A.A.; Metreveli, Z.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1985. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE86702142.

Submitted to the journal Sov. J. Nucl. Phys. .

Multiplicity distributions and correlations between charged secondary particles in the forward and backward hemispheres in the c.m.s. are studied in $\pi^- p$ interactions at 40 GeV/c. It is shown that the mean multiplicities of secondary particles in the forward (quark fragmentation region) and backward (diquark fragmentation region) hemispheres for $\pi^- p$ interactions are approximately equal to half the e^+e^- and pp multiplicities, respectively. The $\pi^- p$ data show correlations between the number of slow forward and slow backward particles, with are described by the model based on dual topological unitarization schemes. It is shown that these correlations are due to those between the particles with opposite charges

from different hemispheres. The fast particles are produced independently.

35067 **(KFK—4011) Search for supersymmetric particles at PETRA.** Kuester, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik). Dec 1985. 12p. (CONF-850721—24). NTIS (US Sales Only), PC A02/MF A01. File Number DE86751752.

From International Europhysics conference on high energy physics; Bari, Italy (18 Jul 1985).

Recent results on searches for scalar leptons, photinos, neutralinos, and charginos in e^+e^- collisions at c.m. energies up to 48.78 GeV are reviewed. (orig.).

6452 Particle Interactions And Properties - Theoretical

REFER ALSO TO CITATION(S) 35094, 35101, 35165, 35169

35068 **(DESY—85-127) Final states lsup(-+)Ksup(+-)Ksup(+-)X in jets as signatures of Bsub(S)^0-anti Bsub(S)^0 mixings.** Ali, A.; Barreiro, F. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.); Universidad Autonoma de Madrid (Spain); Siegen Univ. (Gesamthochschule) (Germany, F.R.)). Nov 1985. 30p. NTIS (US Sales Only), PC A03/MF A01. File Number DE86752055.

Significant mixing is expected between the neutral bottom mesons Bsub(s)sup(o)-anti Bsub(s)sup(o) in the standard model of weak interactions. We propose measurements of the processes e^+e^-(panti p) -> banti b -> $l^+K^-K^-X$ + c.c. as a measure of such mixing. Rates are presented for energetic bottom quark jets, produced in e^+e^- annihilation.

35069 **(ICTP-IC—86-3) Cosmological and astrophysical constraints on particle physics.** Sarkar, S. (International Centre for Theoretical Physics, Trieste (Italy); Oxford Univ. (UK). Dept. of Astrophysics). Jan 1986. 7p. (CONF-850721—25). NTIS (US Sales Only), PC A02/MF A01. File Number DE86901418.

From International Europhysics conference on high energy physics; Bari, Italy (18 Jul 1985).

Based upon considerations of relic abundance of stable particles and observations of the microwave backgroud radiation, major cosmological and astrophysical constraints on elementary particle physics are derived, with particular attention given to supersymmetric particles. Such bounds are intended to be combined with laboratory bounds to test the viability of proposed phenomenological models. 14 refs., 1 fig. (LEW)

35070 **(IFVE-ONF—84-129) Chiral anomalies in knon decays.** Bel'kov, A.A.; Sarikov, N.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1984. 16p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE86702123.

Anomalous currents generated in the Witten topological approach reproduce chiral anomalies in the Born approximation which appear in calculations with common nonanomalous meson currents only in taking account of fermion loops. This permits to theoretical analyse amplitudes of a wide circle of meson processes within the framework of tree approximation.

35071 **(IFVE-OTF—84-15) Multiple production of hadrons in deep-inelastic processes.** Kiselev, A.V.; Petrov, V.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1984. 5p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86702124.

Submitted to the journal JETP Letters .

A formula to describe an average hadron multiplicity <n> on deep-inelastic processes has been proposed. On the basis of available experimental data predictions are made about the behaviour of average multiplicity at higher energies. The W-dependence of <n> observed in experiments at present remains invariable up to energies W approximately 20-25 GeV. At W> or approximately 25 GeV there will begin a rapid increase of <n>, which is analogous to the increase, observed for <n> sub(esup(+)esup(-)) and is of the same nature.

35072 (INIS-SU—320, pp 3-14) **Exact solutions in the theory of a relativistic string with mass at ends.** Barbashov, B.M.; Nesterenko, V.V. (Joint Inst. for Nuclear Research, Dubna, USSR). 1984. (In Russian). NTIS (US Sales Only), PC A16/MF A01. File Number DE86780457. (CONF-8307163—Vol.2).

From 6. international seminar on high energy physics and quantum field theory; Protvino, USSR (1 Jul 1983).

Exact solution in the theory of a relativistic string with masses at ends for three-dimensional space-time is constructed. The solution includes one scalar function of one variable complying with a simple periodicity condition which permits representing it as a Fourier series. This solution describes such motion of the relativistic string when projections of world trajectories of its massive ends on a spatial plane are circumferences. In addition to orthogonal gauge conditions, supplementary gauge conditions are imposed and polar space coordinates are used. It is shown how the relativistic string with massive ends rotating as a whole in the given plane is described in this approach.

35073 (INIS-SU—321, pp 181-191) **Relativistic wave equations for two interacting particles.** Sazdjian, H. (Paris-11 Univ., 91 - Orsay, France. Inst. de Physique Nucleaire). 1984. NTIS (US Sales Only), PC A19/MF A01. File Number DE86780458. (CONF-8407160—Vol.1).

From 7. seminar on problems of high energy physics and quantum field theory; Protvino, USSR (1 Jul 1984).

The paper concerns the construction of relativistic wave equations for two interacting particles. The classical relativistic hamiltonian mechanics of particles interacting at a distance is quantized by the covariant method with constraints.

35074 (INIS-SU—321, pp 343-355) **Heavy meson production in neutrino interactions.** Kartvelishvili, V.G.; Chikovani, E.G.; Ehsakiya, Sh.M. (Tbilisskij Gosudarstvennyj Univ., USSR. Inst. Fiziki Vysokikh Ehnergij). 1984. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE86780458. (CONF-8407160—Vol.1).

From 7. seminar on problems of high energy physics and quantum field theory; Protvino, USSR (1 Jul 1984).

The calculation of inclusive cross-sections is performed for the formation of pseudoscalar quarkonium states in the $\nu+N\to\nu+$etasub(Q)+X reaction. The calculation results are obtained for the model based on the theory of quantum chromodynamics excitations and quarkonium nonrelativistic model. At sufficiently high energies S the form of Psub(T)sup(2) variable distribution (Psub(T) - is a transverse momentum) does not practically depend on the initial energy. S-dependence of the total cross-section of etasub(c) and etasub(b) mesons production in the given process is shown. At high energies the cross-section of etasub(c) meson production accounts for about 10^{-5} from the total cross-section of neutral currents interaction.

35075 (INIS-SU—321, pp 57-79) **Single-mode approximation in quantum theory of relativistic string. String field.** Borodulin, V.I.; Zorin, O.L.; Pron'ko, G.P.; Razumov, A.V.; Solov'ev, L.D. 1984. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE86780458. (CONF-8407160—Vol.1).

From 7. seminar on problems of high energy physics and quantum field theory; Protvino, USSR (1 Jul 1984).

Quantum theory of one-mode string field is analized. The calculation of the width of particles lying in regge trajectory is the simplest example of the application of this theory, and what is more important, all widths are determined by two parameters: interaction constant and regge trajectory slope. The open string under consideration is identified with mesons consisting of light quarks and closed string corresponds to glueballs. The analysis of one-mode configurations of the relativistic string can serve as a useful approximation in the theory of homogeneous interactions and is a first step to the formulation of self-consistent relativistically invariant theory of interacting strings.

35076 (INIS-SU—321, pp 82-84) **Exact solutions in the theory of a relativistic string with massive ends. Part 2.** Barbashov, B.M.; Nesterenko, V.V. (Joint Inst. for Nuclear Research, Dubna, USSR). 1984. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE86780458. (CONF-8407160—Vol.1).

From 7. seminar on problems of high energy physics and quantum field theory; Protvino, USSR (1 Jul 1984).

Exact solutions of motion equations in the theory of a relativistic string with massive ends are presented. It is shown that if the trajectories of string massive ends are circumferential then the helicoid is its universal surface.

35077 (INIS-SU—321, pp 259-266) **Does magnetic charge exist inside hadrons.** Tolkachev, E.A.; Tomil'chik, L.M. (AN Belorusskoj SSR, Minsk. Inst. Fiziki). 1984. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE86780458. (CONF-8407160—Vol.1).

From 7. seminar on problems of high energy physics and quantum field theory; Protvino, USSR (1 Jul 1984).

A possible existence of the magnetic charge inside hadrons is discussed. It is shown that the breaking of P-invariance in the monopole theory results in the prediction of a new meson radiative decay (e.g. vector mesons) within the framework of magneto-charged quark model. Matrix elements are calculated for dipole bremsstrahlung when an electron is scattered on a dyon and a monopole. Arguments supporting possibilities of the application of ep-scattering process at high energies for recording quark magnetic charge.

35078 (INIS-SU—321, pp 388-409) **Finite-energy sum rules and dynamic hadron properties in quantum chromodynamics.** Kataev, A.L.; Krasnikov, N.V.; Pivovarov, A.A. (AN SSSR, Moscow. Inst. Yadernykh Issledovanij). 1984. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE86780458. (CONF-8407160—Vol.1).

From 7. seminar on problems of high energy physics and quantum field theory; Protvino, USSR (1 Jul 1984).

Results of the investigation of dynamic hadron properties by the method of finite-energy sum rules (FESR) are copsidered. Properties of light mesons and baryons are discussed within the framework of FESR. The FESR method allows studying properties not only of the main hadronic states but of their radial excitations as well. It is shown that FESR is a useful method for the investigation of dynamic hadron properties taking into account the highest values of excitation theory corrections as well as the specific features of quantum chromodynamics vacuum.

35079 (INIS-SU—321, pp 237-248) **Dynamic symmetry breaking in the SU(2)sub(L) x U(1) four-fermion model.** Bogush, A.A.; Karpuk, N.N.; Kruglov, S.I. (AN Belorusskoj SSR, Minsk. Inst. Fiziki). 1984. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE86780458. (CONF-8407160—Vol.1).

From 7. seminar on problems of high energy physics and quantum field theory; Protvino, USSR (1 Jul 1984).

A globally SU(2)sub(L)xU(1)-invariant four-fermion field model is analyzed. The formation of collective excitations and fermion mass during the dynamic symmetry breaking is investigated. It is shown that such a model reproduces the main features of the lepton-Higgs sector of the Weinberg-Salam model.

35080 (IPNO-TH—84-72) **Asymptotic theorems and πp p $\rightarrow \pi^0 n$ polarization.** Gauron, P. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). Sep 1984. 8p. (CONF-8409162—24). NTIS (US Sales Only), PC A02/MF A01. File Number DE86751806.

From 6. international symposium on high energy spin physics; Marseille, France (12 Sep 1984).

The surprising results of the recent 40 GeV/c Serpukhov measurement of the polarization in $\pi^- p \rightarrow \pi^0 n$ are shown to support the conjecture that hadronic amplitudes may grow as fast as they are permitted to by general principles.

35081 (ITEP—16(1985)) **Inclusive spectra of baryons in the quark-gluon string model.** Kaidalov, A.B.; Piskunova, O.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1985. 18p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86702127.

Inclusive spectra of nucleons, antinucleons, Λ and anti Λ - hyperons in pp-collisions are calculated in a framework of the quark-gluon string model. It is shown that the model reproduces the main features of the inclusive baryon production. In particular it describes well the rapid increase with energy of the mean anti-baryon multiplicity up to the energy of the SPS-collider.

35082 (ITEP—19(1984)) **Vector and axial constants of baryon decuplet.** Belyaev, V.M.; Blok, B.Yu.; Kogan, Ya.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1984. 12p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86702131.

QCD sum rules for a polarization operator in external axial and vector fields are used to determine the axial and vector constants of transitions in baryonic decuplet $3/2^+$. It is shown that axial constant renormalization is caused by interaction between external axial field and quark condensate.

35083 (ITEP—28(1985)) **Anomalous $l^+ l^- \gamma$ events - manifestation of the composite scalar boson.** Kaidalov, A.B.; Nogteva, A.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1985. 8p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86702132.

It is shown that the properties of the $l^+ l^- \gamma$ anomalous events found at SPS-collider can be understood, if the scalar boson with mass around 90 GeV exists. Its main decay modes and production mechanism in p anti p interactions are discussed.

35084 (ITEP—36(1985)) **Integral condition of the low energy pion wave function.** Gorsky, A.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1985. 7p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86702133.

The condition which must be satisfied by the pion wave function is obtained from comparing the perturbative approach and QCD sum rule method for form factor $\pi^0\gamma\gamma$ at different virtualities of photons.

35085 (ITEP—57(1985)) **On the relation between p anti p annihilation and inclusive reactions with baryon exchange in t-channel.** Volkovitsky, P.E. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1985. 6p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86702134.

In the frame of the Eilon-Harari hypothesis about the contribution of annihilation diagrams to the nonplanar (pomeron) part of the total hadronic cross-section it is shown that three-sheet annilation diagrams have to be compensated by three-sheet diagrams in the crossing channel corrseponding to the baryon exchange in the t-channel. Some predictions are made about the energy dependence and the value of cross sections of processes like pp $\rightarrow$ BB+X with two slow (or fast) baryons and some mesons in the final state. The processes pd $\rightarrow$ (3B)sub(slow)+X are also discussed.

35086 (ITEP—102(1984)) **QCD calculation of power corrections to form factor $\pi 0\gamma\gamma$ at arbitrary virtualities of photons.** Gorsky, A.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1984. 20p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86702125.

The power correction to the $\pi^0\gamma\gamma$ form factor at arbitrary virtualities is derived. It is demonstrated that the most convenient way of calculations is introducing a fixed point gauge for external

gluonic field. The pion asymptotic wave function which contains the valence gluon has been obtained.

35087 **(ITEP—148(1984)) Modern status of the theory of NN interaction.** Kalashnikova, Yu.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1984. 27p. NTIS (US Sales Only), PC A03/MF A01. File Number DE86702126.

Modern status of the theory of NN interaction with the inclusion of quark degrees of freedom is reviewed. The approaches based on unsing the existing quark models of hadrons appear to describe NN scattering experimental data with more or less success, if the well-established longrange OBE interaction is taken into account when constructing the effective NN potential.

35088 **(ITEP—164(1984)) Calculation of excited vector meson electron widths using QCD sum rules.** Geshkenbein, B.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1984. 20p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86702128.

The sum rules are suggested which allow one to calculate the electron widths of excited vector mesons of the psi, upsilon, and rho meson family assuming the values of their masses to be known. The calculated values of the electron widths agree with experiment.

35089 **(ITEP—168(1984)) Power corrections to the asymptotics of the pion electromagnetic form factor.** Gorsky, A.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1984. 25p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86702129.

The first power correction to the pion electromagnetic form factor is derived. A few asymptotic wave functions corresponding to the different series of operators and matrix elements of four-particle operators in pions have been found. The large scale of the first power correction, approximately $10^2(GeV^2)/Q^2$ where Q^2 is the momentum transfer, indicates that at low energies the whole series of power corrections seems to be taken into account.

35090 **(ITEP—180(1984)) F mesons in QCD.** Blok, B.Yu.; Eletskij, V.L. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1984. 11p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86702130.

Masses and residues of charmed strange mesons F and F* are calculated via QCD sum rules. The results are in a good agreement with experiment. An estimate is obtained for msub(s)<anti ss>, where msub(s) is strange quark mass. It is found that mass difference msub(F) - msub(D) = 120 +- 20 MeV, msub(F*) - msub(D*) = 110 +- 20 MeV.

35091 **(SLAC-PUB—3911) Signatures of supersymmetry in e+e⁻ collisions.** Burke, D.L. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Mar 1986. Contract AC03-76SF00515. 50p. (CONF-860736—3). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86009778.

From SLAC summer institute on particle physics; Stanford, CA, USA (29 Jul 1986).

To date a number of searches for evidence for supersymmetry in electron-positron collisions have been made, all with negative results. The techniques used in these searches are reviewed, and their results are examined. The general theoretical and experimental features of supersymmetry are reviewed briefly. 43 refs., 60 figs. (LEW)

35092 **(SLAC-PUB—3951) Theoretical survey of electron-positron physics.** Gilman, F.J. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). May 1986. Contract AC03-76SF00515. 20p. (CONF-860150—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011158.

From Winter condensed matter physics conference: frontiers in condensed matter X-ray physics; Aspen, CO, USA (19 Jan 1986).

The success as well as the incompleteness of the standard model is recalled. We survey some of what has been checked and review the status of some of the parameters which are undetermined within the standard model. Possible areas where there may be problems are indicated and searches for phenomena which come from beyond the standard model are emphasized. 71 refs., 4 figs., 2 tabs.

35093 **Weak decays of heavy flavours - a phenomenological update.** Bigi, I.I. (Stanford Linear Accelerator Center, CA, USA; Technische Hochschule Aachen, Germany, F.R.. Inst. fuer Theoretische Physik). *Physics Letters [Section] B;* **169:** No. 1, 101-105(20 Mar 1986).

Recent data on D decays reveal effects due to colour both as a global and a local quantum number. This conclusion is supported by the observed value of BR(B->psi+X). Weak annihilation has to be a major source of the D^+-D^0 lifetime difference to produce BR(D^0->anti K^0PHI)proportional1/2%. (orig.).

6453 Particle Invariance Principles And Symmetries

35094 **(DESY—85-112) Sneutrino counting.** Grifols, J.A.; Martinez, M.; Sola, J. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Oct 1985. 15p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86752063.

We give a detailed analysis of the reaction e^+e^- -> $\gamma\nu$ tilde ν tilde. If the sneutrino is the lightest supersymmetric particle, detecting a single photon plus missing energy provides an excellent tool for either discover new physics or for setting interesting bounds on the masses of the sneutrino and the wino.

35095 **(DESY—85-136) Quarks and leptons as a coset space phenomenon.** Peccei, R.D. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Dec 1985. 18p. (CONF-8508117—3). NTIS (US Sales Only), PC A02/MF A01. File Number DE86752061.

From 14. international colloquium on group theoretical methods in physics; Seoul, Korea (26 Aug 1985).

I discuss the idea that quarks and leptons may be fermionic partners of Goldstone bosons, arising from the spontaneous breakdown of some global symmetry in a supersymmetric theory. The special role that the complex extension of the symmetry group has for these considerations is emphasized. Some semirealistic examples, involving both ordinary preon models as well as exceptional chains, are given.

6454 Field Theory

REFER ALSO TO CITATION(S) 35166, 35191

35096 **(CBPF-MO—006/85) Relativistic classical strings. II.** Galvao, C.A.P. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1985. vp. (In Portuguese). NTIS (US Sales Only), PC A13/MF A01. File Number DE86702108.

The interactions of strings with electromagnetic and gravitational fields are extensively discussed. Some concepts of differential geometry are reviewed. Strings in Kaluza-Klein manifolds are studied.

35097 **(DESY—85-111) Exact renormalization group as a scheme for calculations.** Mack, G. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.); Hamburg Univ. (Germany, F.R.). 2. Inst. fuer Theoretische Physik). Oct 1985. 28p. (CONF-8508117—4). NTIS (US Sales Only), PC A03/MF A01. File Number DE86752062.

From 14. international colloquium on group theoretical methods in physics; Seoul, Korea (26 Aug 1985).

In this lecture I report on recent work to use exact renormalization group methods to construct a scheme for calculations in quantum field theory and classical statistical mechanics on the continuum.

35098 **(DESY—85-120) Particle structure of gauge theories.** Fredenhagen, K. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.); Hamburg Univ. (Germany, F.R.). 2. Inst. fuer Theoretische Physik). Nov 1985. 39p. (CONF-8507118—1). NTIS (US Sales Only), PC A03/MF A01. File Number DE86752059.

From 6. course on fundamental problems of gauge field theory: a NATO advanced study institute; Erice, Italy (1 Jul 1985).

The implications of the principles of quantum field theory for the particle structure of gauge theories are discussed. The general structure which emerges is compared with that of the Z_4 Higgs model on a lattice. The discussion leads to several confinement criteria for gauge theories with matter fields.

35099 **(DESY—85-121) Status of the standard model.** Peccei, R.D. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Nov 1985. 27p. (CONF-850869—23). NTIS (US Sales Only), PC A03/MF A01. File Number DE86752058.

From Meeting of the Particles and Fields Division of the American Physical Society; Eugene, OR, USA (12 Aug 1985).

I illustrate by means of variety of recent examples how well the standard SU(3)xSU(2)xU(1) model works. Among the topics discussed are: W and Z physics; some aspects of perturbative QCD; theoretical and experimental constraints and prospects for Higgs boson detection; and CP violation within the Kobayashi-Maskawa framework.

35100 **(DESY—85-123) Strong self-coupling expansion in the lattice-regularized standard SU(2) Higgs model.** Decker, K.; Weisz, P.; Montvay, I. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.); Bern Univ. (Switzerland). Inst. fuer Theoretische Physik; Hamburg Univ. (Germany, F.R.). 2. Inst. fuer Theoretische Physik). Nov 1985. 19p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86752057.

Expectation values at an arbitrary point of the 3-dimensional coupling parameter space in the lattice-regularized SU(2) Higgs-model with a doublet scalar field are expressed by a series of expectation values at infinite self-coupling (lambda=infinite). Questions of convergence of this 'strong self-coupling expansion' (SSCE) are investigated. The SSCE is a potentially useful tool for the study of the lambda-dependence at any value (zero or non-zero) of the bare gauge coupling.

35101 **(DOE/CH/40125—6) Theoretical particle physics. Technical progress report, May 1, 1985-April 30, 1986.** Gottlieb, S.A.; Hendry, A.W.; Kostelecky, V.A.; Lichtenberg, D.B. (Indiana Univ., Bloomington (USA). Dept. of Physics). May 1986. Contract AC02-84ER40125. 52p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86011287.

Research activities during this past year included theoretical work in lattice gauge theory, EMC effect, supersymmetry and supergravity, weak interactions including CP violation, and superstrings. Progress in all these areas is reported.

35102 **(FNAL/Pub—86/63-A) Parker limit for monopoles with large magnetic charge.** Hodges, H.M.; Kolb, E.W.; Turner, M.S. (Fermi National Accelerator Lab., Batavia, IL (USA); Chicago Univ., IL (USA)). 28 Apr 1986. Contract AC02-76CH03000. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011021.

The survival of galactic magnetic fields places a limit on the flux of magnetic monopoles, the so-called "Parker limit." Previous discussions of the Parker limit have assumed that the charge of the monopole is the Dirac value, g/sub Dirac/ = 2π/e. However, if the grand unified group is broken by Wilson lines, as is assumed in some superstring models, the minimum value of the magnetic charge is not the Dirac quantum, but an integer multiple of it. In this brief report we investigate the dependence of the Parker limit on the charge of the magnetic monopole. 10 refs., 1 fig.

35103 **(INIS-mf—9884) Jump processes related to the two-dimensional Dirac equation.** Blanchard, P.; Combe, P.; Sirugue, M.; Sirugue-Collin, M. (Forschungszentrum Bielefeld-Bochum-Stochastik (BiBoS), Bielefeld (Germany, F.R.); Bielefeld Univ. (Germany, F.R.). Abt. Theoretische Physik; Aix-Marseille-2 Univ., 13 - Marseille (France); Centre National de la Recherche Scientifique, 13 - Marseille (France). Centre de Physique Theorique; Hirosaki Univ., Aomori (Japan); Aix-Marseille-1 Univ., 13 - Marseille (France)). 1985. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86752048.

BiBoS.; no. 117.

The purpose of this lecture is to present for real time a probabilistic representation for the solution of the two dimensional Dirac equation in terms of pure jump processes, even in the presence of an external electromagnetic field. (orig./HSI).

35104 (INIS-SU—320, pp 15-27) **Conformal anomaly of Toda field theories.** Mansfield, P. (Niels Bohr Inst., Copenhagen, Denmark; Copenhagen Univ., Denmark). 1984. NTIS (US Sales Only), PC A16/MF A01. File Number DE86780457. (CONF-8307163—Vol.2).

From 6. international seminar on high energy physics and quantum field theory; Protvino, USSR (1 Jul 1983).

The conformal anomaly of a class of two-dimensional quantum field theories based on the Toda equations are considered. The theory is considered in Minkowski space and the light-cone is taken as the quantization surface.

35105 (INIS-SU—321, pp 249-258) **Four-dimensional formulation of gauge theories and discrete symmetry breaking.** Avtyushkov, A.P.; Bogush, A.A.; Kurochkin, Yu.A. (AN Belorusskoj SSR, Minsk. Inst. Fiziki). 1984. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE86780458. (CONF-8407160—Vol.1).

From 7. seminar on problems of high energy physics and quantum field theory; Protvino, USSR (1 Jul 1984).

The procedure of transition from five-dimensional ones is realized at the level of action integrals as applied to the general theory of non-abelian gauge fields. The procedure is based on the requirement af the independence of the initial five-dimensional action density from the fifth coordinate. The appearance of additional members in the four-dimensional action conditions the investigation of possibilities of discrete symmetry breaking - P and T (CP).

35106 (INIS-SU—321, pp 297-302) **On diagram technique in field theory at finite temperature.** Mkrtchyan, P.L. (Erevanskij Fizicheskij Inst., USSR). 1984. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE86780458. (CONF-8407160—Vol.1).

From 7. seminar on problems of high energy physics and quantum field theory; Protvino, USSR (1 Jul 1984).

The paper is dedicated to the development of diagram techniques for the computation of different values: stat-sum, effective potential, Green functions - in the relativistic field theory at finite temperature. The analysis of the theory for finite temperature shows that vacuum state averaging is replaced by the averaging of all excited states of a system with Gibbson weight. In the real time formalism it is shown that Dolan-Jakiwa diagrams contain excessive components which should be dismissed.

35107 (INIS-SU—321, pp 373-387) **Gluon condensate from lattice.** Giacomo, A.D. 1984. NTIS (US Sales Only), PC A19/MF A01. File Number DE86780458. (CONF-8407160—Vol.1).

From 7. seminar on problems of high energy physics and quantum field theory; Protvino, USSR (1 Jul 1984).

The problem of gluon condensate from lattice is considered. A short review is presented on the evidence for gluon condensation in Monte Carlo simulations of gauge theories on a lattice. Gluon condensate and heavy q x anti q systems are analyzed. Correlation length of the condensate field strength is determined from lattice.

35108 **(INP—1177/PH) How to eliminate the phase transition in Wadia's model of gauge theory on a lattice.** Jurkiewicz, J.; Zalewski, K. (Institute of Nuclear Physics, Krakow (Poland)). 1982. 6p. (TPJU—2/82). NTIS (US Sales Only), PC A02/MF A01. File Number DE86702109.

It is pointed out that in order to eliminate the phase transition observed in Wadia's model it is necessary to replace Wilson's action by an action unbounded from below. The model is explicity and exactly solved with an action of this kind and indeed there is no phase transition. Since the action proposed is gauge invariant, the standard naive continuum has limit and exhibits no observable pathology. It is suggested that it might be useful also for calculations with lattice versions of more realistic gauge theories.

35109 **(LA-UR—86-1448) Dynamical supersymmetric Dirac Hamiltonians.** Ginocchio, J.N. (Los Alamos National Lab., NM (USA)). 1986. Contract W-7405-ENG-36. 12p. (CONF-8603115—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86010204.

From Symmetries in science II; Carbondale, IL, USA (24 Mar 1986).

Using the language of quantum electrodynamics, the Dirac Hamiltonian of a neutral fermion interacting with a tensor field is examined. A supersymmetry found for a general Dirac Hamiltonian of this type is discussed, followed by consideration of the special case of a harmonic electric potential. The square of the Dirac Hamiltonian of a neutral fermion interacting via an anomalous magnetic moment in an electric potential is shown to be equivalent to a three-dimensional supersymmetric Schroedinger equation. It is found that for a potential that grows as a power of r, the lowest energy of the Hamiltonian equals the rest mass of the fermion, and the Dirac eigenfunction has only an upper component which is normalizable. It is also found that the higher energy states have upper and lower components which form a supersymmetric doublet. 15 refs. (LEW)

35110 **(SLAC-PUB—3909) Superworlds/hyperworlds.** Peskin, M.E. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Mar 1986. Contract AC03-76SF00515. 31p. (CONF-860736—4). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86009780.

From SLAC summer institute on particle physics; Stanford, CA, USA (29 Jul 1986).

Some simple exercises are carried out which clarify the physics of a 5-dimensional world in which one dimension is curled up to a radius R. A technical problem necessary to generalize this discussion to d dimensions is considered - the determination of the sizes of spinors in higher dimensions. The origin of eigenmodes of a higher-dimensional field with exactly zero energy is explored, using as examples conventional models of field theory. General relativity is then reviewed, formulated as a gauge theory. The conditions for the appearance of zero modes in space-time geometries with compactified dimensions are discussed. The physics of these zero modes are illustrated in a series of examples ranging from the original construction of Kaluza and Klein to the superstring theory. 28 refs., 18 figs. (LEW)

35111 **Tomonaga-Schwinger-Dirac formulation for string theories.** Das, S.R.; Rubin, M.A. (Fermi National Accelerator Lab., Batavia, IL, USA). *Physics Letters [Section] B;* **169**: No. 2/3, 182-186(27 Mar 1986).

A Tomonaga-Schwinger-Dirac formulation of the first quantized free bosonic string theory is presented in which all the Virasoro operators have simple geometric meaninga. In a corresponding second quantized version, the "chordal" gauge transformations on the free string field, which generate linearized gauge transformations of spacetime fields, become natural transformations in an extended loop space. The geometrical nature of these transformations may allow them to be more easily generalized to the nonlinear transformations of the interacting string field theory. (orig.).

65 PHYSICS II

6510 Nuclear Physics

35112 **(ANL/NDM—89) Compilation and evaluation of 14-MeV neutron-activation cross sections for nuclear technology applications. Set I.** Evain, B.P.; Smith, D.L.; Lucchese, P. (Argonne National Lab., IL (USA)). Apr 1985. Contract W-31-109-ENG-38. 196p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE86010815.

Available 14-MeV experimental neutron activation cross sections are compiled and evaluated for the following reactions of interest for nuclear-energy technology applications: ^{27}Al(n,p)^{27}Mg, Si(n,X)^{28}Al, Ti(n,X)^{46}Sc, Ti(n,X)^{47}Sc, Ti(n,X)^{48}Sc, ^{51}V(n,p)^{51}Ti, ^{51}V(n,α)^{48}Sc, Cr(n,X)^{52}V, ^{55}Mn(n,α)^{52}V, ^{55}Mn(n,2n)^{54}Mn, Fe(n,X)^{54}Mn, ^{54}Fe(n,α)^{51}Cr, ^{59}Co(n,p)^{59}Fe, ^{59}Co(n,α)^{56}Mn, ^{59}Co(n,2n)^{58}Co, ^{65}Cu(n,p)^{65}Ni, Zn(n,X)^{64}Cu, ^{64}Zn(n,2n)^{63}Zn, ^{113}In(n,n')/sup 113m/In, ^{115}In(n,n') /sup 115m/In. The compiled values are listed and plotted for reference without adjustments. From these collected results those values for which adequate supplementary information on nuclear constants, standards and experimental errors is provided are selected for use in reaction-by-reaction evaluations. These data are adjusted as needed to account for recent revisions in the nuclear constants and cross section standards. The adjusted results are subsequently transformed to equivalent cross sections at 14.7 MeV for the evaluation process. The evaluations are performed utilizing a least-squares method which considers correlations between the experimental data. 440 refs., 41 figs., 46 tabs.

6511 Experimental Techniques

35113 **(INP—1201/PL) System of acquisition and data analysis in application to event-by-event measurements.** Jankowski, K.; Siemaszko, M. (Institute of Nuclear Physics, Krakow (Poland)). 1982. 27p. (In Polish). NTIS (US Sales Only), PC A03/MF A01. File Number DE86702204.

Published in 1983.

A system of acquisition and elaboration of event-by-event measurements written on the magnetic tapes is described. It consists of several programs written for ODRA 1305 computer. The description of these programs as well as the information for users are given. As an example of application of these programs, the results of the analysis of the cross-section measurements for the reaction α + ^{28}Si at Esub(α)=26 MeV are shown. (author).

6512 Nuclear Properties And Reactions, A=1-5, Theoretical

REFER ALSO TO CITATION(S) 35085, 35117

35114 (DOE/ER/01067—24, pp 20-26) **Breakup of deuterons in ^{2}H + n → n + n + p.** Slaus, I.; Treado, P.; Lambert, J.; Naqvi, A. 1985. NTIS, PC A10/MF A01. File Number DE86003851.

In Triangle Universities Nuclear Laboratory annual report - TUNL XXIV, 1 July 1984-31 August 1985.

Experimental methods to measure the vector analyzing powers A/sub y/(Theta) of several processes in the n-d breakup reaction are being developed at TUNL. Several processes which are kinematically allowed illustrate the experimental richness of this reaction. In the final state interactions (FSI), the maximum enhancement to the cross section of the breakup reaction occurs when the relative energy between two of the exiting particles is near zero (E/sub nn/ ~ 0 or E/sub np/ ~ 0). The enhancement to the cross section due to the quasi-free scattering processes (QFS) occurs when the energy of one of the final particles is near zero in the lab frame. Consequently, this particle is commonly referred to as a spectator; nucleons in both the incident projectile and the target can be spectators. Two less-familiar processes are the collinear and star configurations. Collinearity is the special case of QFS in which one of the final particles has nearly zero energy in the c.m. system (spectator) and the other two particles exist with equal momenta in

opposite directions (pvector2 = pvector3), thus the exiting particles form a straight line in the c.m. system. In the star configuration the final particles exit with equal momenta and equal interparticle angles in the c.m. system. Several proposed experiments are described.

35115 (DOE/ER/01067—24, pp 92-93) **Vector analyzing powers of ^{1}H(d,γ) and ^{2}H(p,γ) reactions.** 1985. NTIS, PC A10/MF A01. File Number DE86003851.

In Triangle Universities Nuclear Laboratory annual report - TUNL XXIV, 1 July 1984-31 August 1985.

Our previous work in comparing the vector analyzing powers of the ^{1}H(d,γ) and ^{2}H(p,γ) reactions measured at the same excitation energies indicated the sensitivity of this technique to the presence of channel-spin 3/2 capture amplitudes. Because of backgrounds associated with the deuteron beam, however, the ^{1}H(d,γ)^{3}He data could not be measured with a statistical accuracy comparable to that obtained in the ^{2}H(p,γ)^{3}He case. In order to improve this situation the authors have initiated a new experiment in which the ^{1}H(d,γ) data were taken using the McMaster Enge split-pole spectrograph. By detecting the recoiling ^{3}He nuclei rather than the γ-rays, the background problems were eliminated. A preliminary data set showing Ay as a function of Theta are shown.

35116 (DOE/ER/01067—24, pp 94-95) **Tensor polarized deuteron capture on protons.** 1985. NTIS, PC A10/MF A01. File Number DE86003851.

In Triangle Universities Nuclear Laboratory annual report - TUNL XXIV, 1 July 1984-31 August 1985.

The tensor analyzing power T_{20} for the radiative capture reaction ^{1}H(d/sub pol/,γ)^{3}He has been measured in order to test new three-body wave functions. This observable arises from the D state of ^{3}He. An effective two-body direct-capture calculation, which was previously shown to fit the a_0 coefficient of a Legendre-polynomial expansion of the differential cross sections, is found to give a good description of the present data. A value for the asymptotic D/S ratio is extracted from the data although it is found to be model dependent. In addition to comparing the experimental results with the effective two-body direct capture calculations to test (with remarkable success) the wave functions of Gibson and Lehman, the data were used to extract a value for eta, the ratio of the asymptotic D-to-S state normalization constants.

35117 (DOE/ER/01067—24, pp 96-100) **Tensor analyzing power for the ^{2}H(d,γ)^{4}He reaction.** 1985. NTIS, PC A10/MF A01. File Number DE86003851.

In Triangle Universities Nuclear Laboratory annual report - TUNL XXIV, 1 July 1984-31 August 1985.

The preliminary results of this work were published in Physical Review Letters. Since that time additional experimental and theoretical work has been completed. In addition to T_{20}(Theta), the authors are in the process of measuring T_{22}(Theta), T_{21}(Theta) and iT_{11}(Theta) at the same energy (E/sub d/ = 9.7 MeV) as our previous T_{20}(Theta) results. An effort to perform calculations of these quantities has also been underway both by our group and the group of F. D. Santos et al. In the work of Santos et al., scattering wavefunctions which have phase shifts which were obtained from resonating group calculations were used. The results of these calculations are discussed.

35118 (DOE/ER/01067—24, pp 100-102) **Low energy ^{2}H(d,γ)^{4}He cross sections.** 1985. NTIS, PC A10/MF A01. File Number DE86003851.

In Triangle Universities Nuclear Laboratory annual report - TUNL XXIV, 1 July 1984-31 August 1985.

Preliminary data have been obtained for the ^{2}H(d,γ)^{4}He cross section at incident deuteron energies of 1.0, 2.0, 3.0, 4.0 and 5.0 MeV at an angle of 130° (lab). The results are shown. In addition, an angular distribution was measured at E/sub d/ = 1.4 MeV(center-of-target) and is shown. These data were obtained with a 1.0" gas cell filled to a pressure which varied from 20 psia to 108 psia. The γ-rays were detected with our two 10" x 10" NaI spectrometers. The results of this work are currently being analyzed and interpreted to determine the asymptotic D-to-S state normalization constant implied by these results.

35119 (DOE/ER/01067—24, pp 103-105) **^{2}H(n,γ)^{3}H reaction.** 1985. NTIS, PC A10/MF A01. File Number DE86003851.

In Triangle Universities Nuclear Laboratory annual report - TUNL XXIV, 1 July 1984-31 August 1985.

A study of the ^{2}H(n,γ)^{3}H reaction has been performed employing polarized and unpolarized beams of neutrons. Angular distributions of cross sections have been measured at E/sub n/ = 9.0, 10.8, and 14.0 MeV. An expansion in Legendre polynomials was fit to the data, and the resulting coefficients are reported. Polarized neutrons were employed to measure an angular distribution of analyzing powers at E/sub n/ = 9.0 MeV. Coefficients resulting from fitting an expansion in associated Legendre polynominals to the angular distribution are reported. The combined analyzing power and cross section data at this energy were analyzed under simplifying assumptions to determine significant transition matrix elements of the ^{2}H(n,γ)^{3}H reaction. The data are consistent with (94.0 +/- 3.4)% (S = 1/2) E1, (3.3 +/- 2.7)% (S = 1/2) E2 and (2.7 +/- 2.5)% (S = 3/2) E1 admixtures, where S represents the incident channel spin.

35120 (DOE/ER/01067—24, pp 106-113) **Cross sections and analyzing power at E/sub p/ = 9.0 MeV.** 1985. NTIS, PC A10/MF A01. File Number DE86003851.

In Triangle Universities Nuclear Laboratory annual report - TUNL XXIV, 1 July 1984-31 August 1985.

Angular distributions of cross section and analyzing power were measured for the ^{3}H(p vector,γ)^{4}He reaction at E/sub p/ = 9.0 MeV. A transition matrix element analysis including E1 and E2 terms showed the triplet electric quadrupole ($^3D_3$) amplitude to be larger than predicted by shell model or direct capture calculations. It is shown that the inclusion of M2 terms in the T-matrix element analysis does not reduce the $^3D_3$ amplitude, but that the inclusion of E3 terms does. The data obtained for the present work are shown. The use of two detectors at symmetric angles made possible the reduction of statistical and systematic errors. The angular distribution coefficients are given and show a decrease in error bars by a factor of two to three over those of the previous measurement. Cross sections and analyzing powers are also discussed.

35121 (DOE/ER/01067—24, pp 113-118) **^{3}H(d,γ)^{5}He reaction.** 1985. NTIS, PC A10/MF A01. File Number DE86003851.

In Triangle Universities Nuclear Laboratory annual report - TUNL XXIV, 1 July 1984-31 August 1985.

Experiments with the reaction ^{3}H(d,γ)^{5}He have recently been performed at TUNL using polarized deuteron beams. Very little work has been done previously on this reaction, and none with polarized beam. Previous work consists mainly of measurements of cross sections and cross- section ratios $\sigma(d,\gamma)/\sigma(d,n)$ at energies below 1MeV. Some cross-section measurements have also been done for E/sub d/ = 2-12 MeV. The use of a polarized beam in this experiment will allow us to extract the tensor analyzing power T_{20}(Theta) and thus the admixture of S = 1/2 and S = 3/2 in the ground state. This will be done by comparing our experimental results with a d-^{3}H cluster-model calculation.

35122 (DOE/ER/01067—24, pp 118-123) **Tensor polarized deuteron capture on ^{3}He.** 1985. NTIS, PC A10/MF A01. File Number DE86003851.

In Triangle Universities Nuclear Laboratory annual report - TUNL XXIV, 1 July 1984-31 August 1985.

Work has been initiated at TUNL to investigate the ^{3}He(d,γ)^{5}Li reaction. A run was performed in which the tensor analyzing power T_{20} was measured as a function of angle at deuteron energies of 4 and 8.6 MeV. A direct-capture calculation has been carried out and compared to the experimental result at 8.6 MeV to provide information on the s = 1/2, s = 3/2 channel spin admixture in the ground state of ^{5}Li. Work is being done to improve the theoretical model by using continuum wave functions generated from the elastic scattering phase shifts of B. Jenny et al by using Yamaguchi type form factors.

35123 (DOE/ER/01067—24, pp 123-125) **Wave functions for deuteron capture reactions generated from scattering phase shifts.** 1985. NTIS, PC A10/MF A01. File Number DE86003851.

In Triangle Universities Nuclear Laboratory annual report - TUNL XXIV, 1 July 1984-31 August 1985.

Computer codes have been written to generate complex wavefunctions for the $^2S_2^-$, $^2D_2^-$, $^0D_2^-$, and $^2G_2^-$ radial scattering waves (/sup S/L/sub J/ notation) using the separable Yamaguchi potential. Wavefunctions generated in this manner can be made to represent a range of low-energy scattering data and should correspond more closely to the physical situation than the wavefunctions generated by the previous method which used an optical model potential.

35124 (DOE/ER/01067—24, pp 135-139) **^{1}H(^{7}Li,n)^{7}Be reaction as a neutron source for capture reaction studies.** 1985. NTIS, PC A10/MF A01. File Number DE86003851.

In Triangle Universities Nuclear Laboratory annual report - TUNL XXIV, 1 July 1984-31 August 1985.

In the development of the ^{1}H(n,γ) experiment, the ^{1}H(^{7}Li,n)^{7}Be reaction has been investigated as an intense and tightly collimated neutron source. As was pointed out by J. H. Dave et al., a negative Q-value reaction such as this, close to threshold, produces a beam of neutrons that is kinematically restricted to a narrow forward angle. The narrow collimation of this beam gives it a significant advantage over the neutron beam from the ^{2}H(d,n) reaction.

35125 **(UEF—02-84) Characteristics of spectators in ^{4}He nuclei fragmentation processes.** Bano, M.; Braun, H.; Futo, A. (Slovenska Akademia Vied, Kosice (Czechoslovakia). Ustav Experimentalnej Fyziky; Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). Oct 1984. 17p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86702152.

Characteristics of deuterons, ^{3}H and ^{3}He spectators emitted in ^{4}He-p interactions at 8.6 GeV/c incident momentum were studied. A model using the Monte Carlo procedure is proposed which predicts the momentum distribution for a nucleon or a group of nucleons (d, ^{2}H, ^{3}He) in the ^{4}He nucleus and describes some properties of reaction channels with spectator emission. The predictions are compared with experimental data. Good agreement is obtained taking into account the influence of the experimental errors and of the binding energy between the fragments.

6513 Nuclear Properties And Reactions, A=6-19, Theoretical

REFER ALSO TO CITATION(S) 35127

35126 (DOE/ER/01067—24, pp 27-31) **Scattering from ^{9}Be.** 1985. NTIS, PC A10/MF A01. File Number DE86003851.

In Triangle Universities Nuclear Laboratory annual report - TUNL XXIV, 1 July 1984-31 August 1985.

The authors have now enlarged their ^{9}Be Lane model data base to include (n,n) A/sub y/(Theta) and their new time-of-flight measurements of (p,n) σ(Theta) and A/sub y/(Theta), thereby establishing the first model-complete data base and increasing the energy to 17 MeV. While earlier studies have investigated the central part of U_1 (r) by including σ(Theta) for all three channels, this is the first study to investigate a full complex isovector spin-orbit potential by also including the complete set of A/sub y/(Theta) measurements. It is seen that the model is largely successful in describing the data for all three channels. The most serious deficiencies occur in the forward angle minimum of σ(Theta) and the backward-angle maximum of A/sub y/(Theta) for the (p,n) reaction, both regions in which a simple direct-reaction approach is particularly limited.

35127 (DOE/ER/01067—24, pp 31-36) **Lane model analysis for ^{11}B and ^{10}B.** 1985. NTIS, PC A10/MF A01. File Number DE86003851.

In Triangle Universities Nuclear Laboratory annual report - TUNL XXIV, 1 July 1984-31 August 1985.

The results of the boron studies have been reported in a contribution to the International Conference on Nuclear Data for Basic and Applied Science, Santa Fe. For both nuclei the authors extended the previous neutron scattering σ(Theta) measurements up to 17 MeV and measured A/sub y/(Theta) at 10 and 15 MeV. For ^{10}B the addition of these higher energies is of particular interest because around 14 MeV the imaginary-potential strength undergoes a dramatic change in slope which should be reflected in the imaginary Coulomb correction. For ^{11}B(p,n) the authors measured σ(Theta) and A/sub y/(Theta) from 12 to 17 MeV. The A/sub y/(Theta) measurements permitted an investigation of the existence of an $i^7 \times s$ part of U_1. The (p,p) σ(Theta) data from 10 to 13.4 MeV and 17.9 MeV were taken from Watson. A linear parameterization of Legendre coefficients for these data provided values at 14, 15, and 17 MeV.

35128 (DOE/ER/01067—24, pp 36-37) **Analyzing powers for ^{14}N(n,n) and ^{16}O(n,n).** 1985. NTIS, PC A10/MF A01. File Number DE86003851.

In Triangle Universities Nuclear Laboratory annual report - TUNL XXIV, 1 July 1984-31 August 1985.

In the measurements of A/sub y/(Theta) for ^{6}Li(n,n) contaminant peaks in the time-of-flight spectra were identified as nitrogen and oxygen, abundant in about equal amounts and at a level of about 8% (each) of the ^{6}Li, by nuclear density. At forward angles counts from these contaminants were not separable from the ^{6}Li counts. Therefore, it was necessary to determine A/sub y/(Theta) for ^{14}N and ^{16}O. Two types of samples, H_2O and BeO, were used for ^{16}O, and the rocket fuel hydrazone (H_4N_2) was used for ^{14}N. Data have been obtained at forward angles below 10 MeV and full angular distributions were measured for completeness at 10, 12, 14 and 17 MeV.

35129 (DOE/ER/01067—24, pp 125-130) **Radiative capture of neutrons and deuterons into ^{13}C: evidence for a secondary doorway state effect.** 1985. NTIS, PC A10/MF A01. File Number DE86003851.

In Triangle Universities Nuclear Laboratory annual report - TUNL XXIV, 1 July 1984-31 August 1985.

Differential cross sections were measured at a detector angle of 90° in the lab for the ^{12}C(n,γ_0)^{13}C reaction at 19 incident neutron energies between 6.5 and 18.5 MeV. This energy region spans the pygmy and T < giant dipole resonance in ^{13}C. Angular distributions of cross section were measured for this reaction at 7 incident neutron energies between 12.0 and 18.5 MeV. Angular distributions of vector analyzing power were measured for the ^{12}C(n,γ_0)^{13}C reaction at 4 incident neutron energies between 12.0 and 18.2 MeV, analyzing powers were measured at 125° for neutron energies of 15.4, 17.4, and 18.8 MeV. Measurements were made of the 90° cross sections of the ^{11}B(d,γ_0)^{13}C reaction in the energy region of the previously reported secondary doorway state in ^{13}C. Angular distribution data of the cross section, vector analyzing power, and tensor analyzing power T_{20}(Theta) were measured over the same energy region.

35130 (DOE/ER/01067—24, pp 130-133) **^{11}B(p,γ)^{12}C - ^{3}H(p,γ)^{4}He cross section ratio.** 1985. NTIS, PC A10/MF A01. File Number DE86003851.

In Triangle Universities Nuclear Laboratory annual report - TUNL XXIV, 1 July 1984-31 August 1985.

A new measurement to determine the ratio of the differential cross sections ^{3}H(p,γ)^{4}He to ^{11}B(p,γ)^{12}C has been completed. These two (p,γ) cross sections have been important as part of the comparison of (p,γ) to (n,γ) cross sections in self conjugate nuclei. This comparison is used as a test of isospin mixing in the giant dipole resonance region for ^{4}He, ^{12}C and other self conjugate nuclei.

35131 **(ITEF—94(1984)) Excitation of ^{16}O (6.13 MeV) nucleus by π^+-mesons with 2.0 GeV/c momentum.** Kirpichnikov, I.V.; Kuznetsov, V.A.; Starostin, A.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1984. 11p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE86702153.

Angular gamma radiation distribution with 6.13 MeV emmitted at 3⁻ level excitation of ^{16}O nucleus by π^+ mesons with 2.0 GeV/c momentum is measured. The nucleus alignment in finite state is determined and partial cross sections σsub(M) of the $^{16}O(\pi, \pi)^{16}O^*(3^-)$ reaction characterized by definite M values of spin projection on axis coinciding with the direction of the incident beam are obtained. The measurement results at small-angle pion scattering are in good agreement with the calculations performed in terms of the Glauber theory for $^{16}O(\pi, \pi')^{16}O^*(3^-)$ quasielastic reaction. A considerable part of excitation cross section (approximately 0.5 σsub(B)) however is connected with large-angle scattering and may be attributed to channels with production of new particles.

35132 (ITEF—98(1984)) Energy and A-dependences of pion yields from nuclei at initial energies from 1.0 to 9.0 GeV/c. Bayukov, Yu.D.; Gavrilov, V.B.; Goryainov, N.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1984. 19p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE86702151.

The dependences of charged pion yields from nuclei on the momentum and type of the bombarding particle and atomic weight of the nucleus-target are measured and analyzed. The measurements are performed at 59, 89, 119 and 160 deg angles in pA (A=Be, C, Al, Ti, Fe, Cu, Nb, Cd, Sn, Ta, Pb, U) and πsup(+-)A (A=C, Cu, Pb, U) - interactions at bombarding particles momenta of 1-9 GeV/c and 1.0-6.0 GeV/c, respectively. The obtained differential cross section values of pion production are tabulated. Given are graphical dependences of pion yields from different nuclei on the bombarding hadron momentum for various exit angles. For all angles the pion yield value is changed with the initial momentum growth differently for various bombarding particles, the change in the yield value is decreased with the initial momentum growth. The more the nucleus-target atomic weight the stronger the dependence of pion yields on the bombarding particle momentum. Differential cross section of pions production in pA- interactions at 7.5 GeV/c is described rather well by the Asup(α) form dependence (particularly for 119 and 160 deg angles); α=1. The α values increases with the initial momentum growth up to approximately 5-6 GeV/c then it goes out on the constant value. Such a behaviour is identical for various bombarding particles.

35133 (ITEF—126(1984)) Study on the correlations of cumulative protons escaping at 120 deg angle from Be, C, Al, Ti, Cu, Nb, Cd, Ta, Pb, U nuclei under the action of 7.5 GeV/c protons. Bayukov, Yu.D.; Degtyarenko, P.V.; Vlasov, A.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1984. 28p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE86702149.

The correlations of cumulative protons escaping at fixed angle theta=120 deg from Be, C, Al, Ti, Cu, Nb, Cd, Ta, Pb, U nuclei under identical conditions at 7.5 GeV/c initial s protons momenta have been studied. The dependence of the R correlation coefficient on the difference of azimuthal angles of proton escapes has been observed stronger the lighter the nucleus and R increases with the growth of atomic number of the target nuclei. It is concluded that the proton escapes cannot be considered as independent.

35134 (ITEF—144(1984)) Cross section of the particle yield under the 3.5 deg angle in the interactions of protons of 2.03; 4.54; 4.75; 4.95 GeV/c with the Al, Be, Cu, Ta nuclei. Vorontsov, I.A.; Safronov, G.A.; Sibirtsev, A.A.; Smirnov, G.N.; Stepanov, N.V.; Trebukhovskij, Yu.V.; Fomkin, V.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1984. 14p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE86702150.

Yields of π^+, p, d produced in the interactions of incident protons at 4.54; 4.75; 4.95 GeV/c with Be, Al, Cu, Ta nuclei are investigated. Measurements were performed by time-of-flight spectrometer made on the base of separated beam of ITEP proton synchrotron. Tables of inclusive differential cross sections of investigated reactions are presented. Yields of d, t produced by protons of 2.03 GeV/c were measured. Special attention is paid to the investigation of yields of deuterons with extremely large momenta (the region of direct reactions $pp \rightarrow d\pi^+$, $pd \rightarrow dp$).

6514 Nuclear Properties And Reactions, A=20-38, Theoretical

REFER ALSO TO CITATION(S) 35146

35135 (DOE/ER/01067—24, pp 44-60) High resolution resonance studies with the (p,p) and (p,α) reactions. Bilpuch, E.G.; Mitchell, G.E.; Brooks, W.; Bull, J.; Fields, K.; James, L.; Nelson, R.O.; Smith, B.; Vanhoy, J.; Warthen, B.; Westerfeldt, C.R. 1985. NTIS, PC A10/MF A01. File Number DE86003851.

In Triangle Universities Nuclear Laboratory annual report - TUNL XXIV, 1 July 1984-31 August 1985.

Recently the authors have extended their high resolution studies to targets with spin. A series of measurements on non-zero spin targets in the 2s-1d shell is now in progress. In section b the analysis of resonance data for targets with spin is described, with emphasis on s and l mixing. In sections c and d the authors briefly summarize the published data on ^{27}Al and ^{25}Mg, while in sections e, f, and g preliminary results for ^{33}S, ^{39}K, and ^{23}Na are described. The relevance of the entrance channel relative phase to a class of parity mixing experiments is discussed in section h.

35136 (DOE/ER/01067—24, pp 68-71) Isospin mixing in light nuclei. Ludwig, E.J.; Clegg, T.B.; Fauber, R.E.; Karwowski, H.J.; Mooney, T.M.; Thompson, W.J. 1985. NTIS, PC A10/MF A01. File Number DE86003851.

In Triangle Universities Nuclear Laboratory annual report - TUNL XXIV, 1 July 1984-31 August 1985.

This program has provided accurate measurements of isospin mixing (ΔT = 1,2) in proton elastic scattering on even-even target nuclei up to A = 40. In order to improve experimental results and to test the hypothesis that isospin mixing is dominated by mixing in the target ground state (as opposed to mixing in the compound system) the authors have undertaken to (1) extend the proton scattering results to additional T = 3/2 states in certain compound systems and (2) examine processes which can proceed by only isotensor mixing (ΔT = 2) in order to isolate the effects of that contribution.

35137 (DOE/ER/01067—24, pp 86-89) Delayed proton decay of ^{33}Ar. Schneider, M.B.; Karwowski, H.J.; Spencer, T.C.; Conway, D. 1985. NTIS, PC A10/MF A01. File Number DE86003851.

In Triangle Universities Nuclear Laboratory annual report - TUNL XXIV, 1 July 1984-31 August 1985.

It has been recognized for many years that delayed particle decay (alpha, proton or neutron decay after a beta decay) is sensitive to the kinematics of the β decay. Recoil ion energies subsequent to a beta decay are of the order of 100 eV for light isotopes. If this daughter nucleus is unstable to particle decay, the ion recoil will cause a kinematic shift in the particle energy in the lab frame of the order of 10 keV, which is easily detected with current semiconductor particle detectors. This technique has been used to probe the beta-neutrino angular correlation by detecting the alpha-alpha angular correlation in the decay of ^8Li, by observing increased spectral width of the delayed particles, or by observing a centroid particle energy difference between spectra in coincidence with beta particles at various angles to the particle decay direction. This latter technique has the most applications, and is the one the authors will exploit to investigate the nuclear and weak interaction physics of the beta decay of ^{33}Ar.

35138 (DOE/ER/01067—24, pp 139) Search for high-spin states in ^{25}Mg. 1985. NTIS, PC A10/MF A01. File Number DE86003851.

In Triangle Universities Nuclear Laboratory annual report - TUNL XXIV, 1 July 1984-31 August 1985.

An experiment was performed to test the predictions of the so-called cranked Nilsson Model of the s-d shell nucleus ^{25}Mg in

high spin states. A specific goal was to find and measure the energy of a predicted $13/2^+$ state, expected to exist at around 7.5 to 8 MeV as a rotational isomer to the known $13/2^+$ state at 5.461 MeV. High spin states of ^{25}mg were produced via the $^{12}C(^{14}N,p)^{25}Mg$ reaction. The Nitrogen beam was produced in the TUNL charge exchange source by using a mixture of one part Nitrogen to three parts Hydrogen as the duoplasmatron source gas. This produced a good beam of which similarly ordered 200 nA of triply ionized ^{14}N could be delivered to the target.

35139 (INIS-BR—461, pp 85) **Production of ^{22}Na source.** Britto, J.L.Q. de. 1984. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. File Number DE86702106.

In Annual technical report of Nuclear Engineering Institute - Physics Department - 1984.

6515 Nuclear Properties And Reactions, A=39-58, Theoretical

REFER ALSO TO CITATION(S) 35155

35140 (DOE/ER/01067—24, pp 6-10) **Elastic and inelastic neutron scattering from ^{40}Ca up to 80 MeV.** 1985. NTIS, PC A10/MF A01. File Number DE86003851.

In Triangle Universities Nuclear Laboratory annual report - TUNL XXIV, 1 July 1984-31 August 1985.

Differential cross sections σ(Theta) and analyzing powers A/sub y/(Theta) for neutron scattering to the ground and first 3^- excited states of the double-closed-shell nuclear ^{40}Ca have been measured in the energy range from 11 to 17 MeV. These measurements have been combined with other neutron σ(Theta) data from Ohio University and from M.S.U., previous TUNL A/sub y/(Theta) data, and total cross section measurements to form a large set of scattering and reaction data for incident energies up to 80 MeV. The data have been described in the framework of coupled-channel formalism.

35141 (DOE/ER/01067—24, pp 11-12) **Elastic and inelastic scattering from ^{54}Fe and ^{58}Ni.** 1985. NTIS, PC A10/MF A01. File Number DE86003851.

In Triangle Universities Nuclear Laboratory annual report - TUNL XXIV, 1 July 1984-31 August 1985.

A new CC analysis for ^{58}Ni is proceeding. This analysis is an extension of the work of Guss and incorporates the new TUNL 17 MeV σ(Theta) and A/sub y/(Theta) elastic and inelastic (to the first 2^+ excited state) scattering data into the ^{58}Ni data base of Guss. Also included in the analysis are new A/sub y/(Theta) data for inelastic scattering to the first 2+ excited state of ^{58}Ni at 10 and 14 MeV. The inelastic A/sub y/(Theta) data are being used to study the relationship between the spin-orbit and central potential deformation lengths. A CC analysis for ^{54}Fe is proceeding in the same manner as that for ^{58}Ni. The parameters of this analysis have the same types of energy dependencies as those of the ^{58}Ni parameters. The data base for this analysis contains the elastic and inelastic (for the first 2^+ excited state) σ(Theta) data of El-Kadi from 8 to 14 MeV, of Mellema[6] at 11 MeV and from 20 to 26 MeV, and the new TUNL 17 MeV data.

35142 (DOE/ER/01067—24, pp 61-67) **Amplitude correlations.** Mitchell, G.E.; Bilpuch, E.G.; Ramakrishnan, P.; Vanhoy, J.; Westerfeldt, C.R.; Shriner, J.F. Jr. (Yale Univ., New Haven, CT). 1985. NTIS, PC A10/MF A01. File Number DE86003851.

In Triangle Universities Nuclear Laboratory annual report - TUNL XXIV, 1 July 1984-31 August 1985.

The study of amplitude correlations has continued to be productive. In these measurements magnitudes and relative signs of decay amplitudes are determined for isolated compound nuclear resonances. The (p,p') reaction is employed on zero spin targets. Inelastic decay from the compound state ($J\ \pi$) to the first excited state (2^+) in general proceeds via several channels - the relative signs and magnitudes of these amplitudes are determined. The bulk of the data are for $3/2^+$, $3/2\surd$, and $5/2^-$ resonances. For $3/2^-$ and $5/2^+$ resonances singles measurements of the p' and γ-ray angular distributions are sufficient to uniquely determine the mixing parameters, while for $3/2^+$ resonances an additional experiment is required. Results for Co-57 are discussed.

35143 (DOE/ER/01067—24, pp 72-79) **Global optical analysis of nucleon-nucleus elastic scattering.** Varner, R.L.; Clegg, T.B.; Ludwig, E.J.; McAbee, T.L.; Thompson, W.J. 1985. NTIS, PC A10/MF A01. File Number DE86003851.

In Triangle Universities Nuclear Laboratory annual report - TUNL XXIV, 1 July 1984-31 August 1985.

The authors have completed an optical model analysis of a large amount of nucleon-nucleus elastic scattering data. They have incorporated into this analysis a new database of polarized proton elastic scattering and neutron elastic scattering data, a new global optical model analysis program running on a high-speed numerical processor, and an optical model potential in which the parameters are functions of the target A and Z and the incident nucleon E and Z; the functional forms were chosen based on semi-empirical (folding model) considerations and well-known phenomenological observations.

6516 Nuclear Properties And Reactions, A=59-89, Theoretical

REFER ALSO TO CITATION(S) 35143, 35146

35144 (DOE/ER/01067—24, pp 12-14) **Elastic scattering cross section for ^{89}Y and ^{93}Nb.** 1985. NTIS, PC A10/MF A01. File Number DE86003851.

In Triangle Universities Nuclear Laboratory annual report - TUNL XXIV, 1 July 1984-31 August 1985.

Measurements of σ(Theta) for elastic scattering of neutrons at energies of 7.9, 9.9, 11.9, 13.9, and 16.9 MeV from ^{89}Y have been prepared in final form. A systematic, energy-dependent spherical optical model (SOM) parametrization of elastic scattering from this nucleus has now been completed. The differential cross section data compared to these SOM calculations at each energy are shown. The data have also been incorporated in the global SOM study of many nuclei.

35145 (DOE/ER/01067—24, pp 38-40) **Scattering of polarized neutrons from medium-weight nuclei.** 1985. NTIS, PC A10/MF A01. File Number DE86003851.

In Triangle Universities Nuclear Laboratory annual report - TUNL XXIV, 1 July 1984-31 August 1985.

Differential cross sections for neutron scattering from ^{58}Ni and ^{60}Ni to the ground state and first excited state have been measured at 8, 10, 12 and 14 MeV. In addition, analyzing powers were measured for scattering to the same states for ^{58}Nk at 10 and 14 MeV, and for ^{60}Ni at 10 MeV. The data were analyzed in the framework of a coupled-channel formalism. The analyzing power A/sub y/(Theta) for (n,n_1) scattering for ^{54}Fe and ^{56}Fe have been put into final form. These data comprise distributions at 10 MeV for both nuclei and at 14 and 17 MeV for ^{54}Fe. As in the case of ^{58}Ni, a coupled-channel description over a wide energy range (10 keV < E < 80 MeV) has been attempted, and moderate success has been achieved. Final data sets have been prepared for analyzing powers A/sub y/(Theta) obtained for the elastic scattering of neutrons from ^{89}Y at energies of 9.9, 13.9, and 16.9 MeV. These data and our σ(Theta) data have been analyzed in the framework of the spherical optical model (SOM).

35146 (DOE/ER/01067—24, pp 79-86) **Deuteron-induced reactions.** Bhat, C.; Bowsher, J.E.; Clegg, T.B.; Karwowski, H.J.; Ludwig, E.J.; Santos, F.D.; Eiro, A. (Univ. of Lisbon, Portugal). 1985. NTIS, PC A10/MF A01. File Number DE86003851.

In Triangle Universities Nuclear Laboratory annual report - TUNL XXIV, 1 July 1984-31 August 1985.

This work has the goal of making a determination of the component of the alpha-particle wavefunction corresponding to two deuteron clusters in a relative D state. This produces information about the non-spherical parts of the nucleon-nucleon force. Tensor analyzing powers (TAP) for unnatural parity transitions in (d vector, α) reactions are particularly sensitive to D-state effects in the d-d relative motion in the α particle. The TAP for (d vector, α)

reactions, however, are also sensitive to the mixing of contributions from different values of the orbital angular momentum, L, and total angular momentum J. These (L,J) mixing contributions, determined from comparisons of data to theoretical calculations, provide information about the two-particle configurations of the target nucleus. The authors have made efforts to (1) use shell model wave functions to determine the (L,J) admixtures and then to adjust the D-state admixture to provide the best comparison to the experimental data thereby establishing the D-state contribution and (2) include the appropriate D-state admixture in calculations in order to establish the (L,J) contributions and two-particle configurations involved in a given reaction.

35147 (INIS-BR—461, pp 33) **Excitation function and isomeric ratio of ^{89}Nb in the ^{90}Zr (p, 2n) reaction.** Cabral, S.C.; Auler, L.T.; Silva, A.G. da. 1984. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. File Number DE86702106.

In Annual technical report of Nuclear Engineering Institute - Physics Department - 1984.

35148 (INIS-BR—461, pp 33-34) **Excitation functions and isomeric ratio of the ^{89}Y (^{3}He,3n) ^{89}Nb.** Vinagre Filho, U.M.; Costa, V.L. da; Auler, L.T.; Silva, A.G. da. 1984. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. File Number DE86702106.

In Annual technical report of Nuclear Engineering Institute - Physics Department - 1984.

6517 Nuclear Properties And Reactions, A=90-149, Theoretical

REFER ALSO TO CITATION(S) 35143, 35155, 35168

35149 (DOE/ER/01067—24, pp 166-170) **Photon production cross section measurements for Ta and Be.** Gould, C.R.; Dave, J.; Mitchell, G.E.; Ramakrishnan, P.; Dial, S.; Auchampaugh, G.F.; Little, R.C.; Wender, S.A. (Los Alamos National Lab., NM). 1985. NTIS, PC A10/MF A01. File Number DE86003851.

In Triangle Universities Nuclear Laboratory annual report - TUNL XXIV, 1 July 1984-31 August 1985.

Recently intense beams of neutrons have become available at WNR, the white neutron source at the Los Alamos Meson Physics Facility. This source has excellent characteristics for γ-ray production cross section studies. A program of measurements is now in progress using an array of five bismuth germanate (BGO) detectors. The good detection efficiency of BGO at high γ-ray energy, combined with the ability to measure complete angular distributions, provides a unique capability for performing neutron induced γ-ray production cross section measurements up to 100 MeV neutron energy. The authors present preliminary data for experiments with Ta and Be.

35150 (INIS-BR—461, pp 78) **Preparation of ^{111}Ag by the sup(Nat) Pd(d,p) ^{111}Pd → ^{111}Ag reaction.** Vinagre Filho, U.M.; Costa, V.L. da; Auler, L.T.; Silva, A.G. da. 1984. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. File Number DE86702106.

In Annual technical report of Nuclear Engineering Institute - Physics Department - 1984.

35151 (INIS-BR—461, pp 84-85) **Production of Cd 109.** Bastos, M.A.V.; Chamma, D.F.S. 1984. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. File Number DE86702106.

In Annual technical report of Nuclear Engineering Institute - Physics Department - 1984.

35152 (JINR—R-4-85-249) **M2-transitions between low-lying states of odd nuclei and core magnetic polarization.** Vdovin, A.I.; Rodriges, O.O.; Andrejchev, V.; Stoyanov, Ch. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1985. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE86702145.

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The reduced probabilities of M2-transitions between the low-lying states $11/2^-_1$ and $7/2_1^+$ in Sn, Sb, Pr, Pm and Eu isotopes and $15/2_1^-$ and $11/2_1^+$-states in sup(209)Pb are calculated within the quasiparticle-phonon nuclear model. The M2-polarization of the even-even core reduces the B(M2)-values by 3-4 times as compared with the single-particle limit. The core polarization effect is strongest when the isoscalar spin-dipole interaction vanishes. In spite of this strong reduction B(M2)sub(theor) are still by 4-5 times larger than the experimantal values of B(M2) in all the nuclei under consideration except for sup(209)Pb. So, it is necessary to use too small values of effective spin gyromagnetic factors (gsub(e)sup(eff) approximately 0.5gsub(s)sup(free)). In sup(209)Pb theory and experiment are in agreement at the usual values of gsub(s)sup(eff) approximately 0.8gsub(s)sup(free).

6518 Nuclear Properties And Reactions, A=150-189, Theoretical

REFER ALSO TO CITATION(S) 35143, 35152

35153 (CONF-8505153—3) **Entry state distributions of discrete yrast transitions in heavy ion induced fusion reactions.** Lee, I.Y.; Baktash, C.; Beene, J.R.; Fewell, M.P.; Halbert, M.L.; Johnson, N.R.; McGowan, F.K.; Milner, W.T.; Kim, H.; Sayer, R.O.; Sarantites, D.G. (Oak Ridge National Lab., TN (USA); Washington Univ., St. Louis, MO (USA)). 28 May 1985. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010619.

From Symposium on electromagnetic properties of high spin; Stockholm, Sweden (28 May 1985).

Gamma rays emitted during yrast transitions from compound nuclei are detected with a 4π multielement gamma ray detector system. Both total pulse height (H) and coincidence fold data (k) are obtained for each event. Results presented include entry state distribution states, k and H projections for some of these distributions, and k and H as a function of spin of the yrast transition. 5 figs. (DWL)

35154 **The transport of 14-MeV neutrons through heavy materials 150 < A < 208.** Hansen, L.F.; Blann, H.M.; Howerton, R.J.; Komoto, T.T.; Pohl, B. (University of California, Lawrence Livermore National Laboratory, Livermore, CA 94550). *Nuclear Science and Engineering;* **92**: No. 3, vp(Mar 1986).

The emission spectra from holmium (0.8 mfp), tantalum (1 and 3 mfp), gold (1.9 mfp), and lead (1.0 mfp) have been measured using the sphere transmission and time-of-flight techniques. The 14-MeV incident neutrons are from the Lawrence Livermore National Laboratory insulated-core-transformer accelerator using the ^{3}H(d,n)^{4}He reaction. These materials were chosen to span a wide range of heavy nuclei, including deformed (holmium and tantalum), spherical (gold), and closed-shell (lead) nuclei. The neutron emission spectra have been measured in the 1- to 15-MeV energy interval and the results compared with Monte Carlo calculations performed using the neutron-photon transport code TART and evaluated neutron cross-section files. An alternative representation of the secondary neutron spectra has been carried out by using model calculations for precompound processes and collective effects in the calculations of the pulsed sphere emission spectra. Their importance in the quality of the agreement between measurements and calculations is discussed. The measurements are compared with the predictions of two evaluated neutron libraries, the ENDF/B-V and evaluated nuclear data library (ENDL). In addition, calculations have been carried out using neutron cross sections calculated directly from well-accepted nuclear models by the ALICE/LIVERMORE 82 and ECIS 79 codes. The quality of the agreements between the measurements and calculations obtained with the latter cross sections and those from the ENDL library is reasonably good for all the targets, and these are systematically better than the results obtained with the ENDF/B-V files. Discrepancies between measurements and calculations as great as 80% are found using the ENDF/B-V files for the emission of neutrons from gold in the 5- to 10-MeV energy range.

6519 Nuclear Properties And Reactions, A=190-219, Theoretical

REFER ALSO TO CITATION(S) 35143, 35152, 35168

35155 (DOE/ER/01067—24, pp 41-43) **Imaginary part of the spin-orbit interaction for neutron-nucleus scattering.** 1985. NTIS, PC A10/MF A01. File Number DE86003851.

In Triangle Universities Nuclear Laboratory annual report - TUNL XXIV, 1 July 1984-31 August 1985.

After the recent nuclear-matter calculations of Brieva and Rook for the nucleon-nucleus interaction, there has been a renewed interest in the phenomenology of the imaginary part W/sub so/(r) of the spin-orbit term. Spherical and deformed optical model analyses of the TUNL data for ^{40}Ca, ^{120}Sn, and ^{208}Pb strongly suggest the existence of W/sub so/(r) with a depth W/sub so/ ≧ + 0.7 MeV, where the positive sign indicates the same sign as the real spin-orbit potential depth V/sub so/. This sign is opposite to that predicted for (p,p) scattering above 30 MeV. The results for A/sub y/(Theta) are shown and correspondingly good fits were obtained for the other observables in these scattering analyses.

35156 (DOE/ER/40048—154-L6) **Spin distributions in near-barrier and sub-barrier fusion reactions.** Vandenbosch, R. (Washington Univ., Seattle (USA). Dept. of Physiology and Biophysics). 25 Mar 1986. Contract AC06-81ER40048. 19p. (CONF-860396—8). NTIS, PC A02/MF A01; GPO Dep. File Number DE86010453.

From Symposium on the many facets of heavy ion fusion reactions; Argonne, IL, USA (24 Mar 1986).

A new study of the mean-square value of the spin distribution of compound nuclei, exploiting the sensitivity of fission fragment angular distributions to the compound nucleus spin distribution, is described. The technique is extended to low sub-barrier and near barrier energies. The spin distribution for two entrance channels involving deformed nuclei and leading to the compound nucleus ^{248}Cf and the ^{16}O + ^{208}Pb system, where the target nucleus is spherical, are studied. Comparisons are made of mean spin values and excitation functions computed using experimental data with model predictions. The author concludes that models which are successful in accounting for the shapes of sub-barrier excitation functions fail to reproduce the mean-square spin values at the lowest bombarding energies. 26 refs., 8 figs. (DWL)

35157 (INIS-BR—461, pp 35-36) **Excitation functions and isomeric ratio of ^{197}Au (^{3}He,2n) ^{198}Tl.** Vinagre Filho, U.M.; Costa, V.L. da; Auler, L.T.; Silva, A.G. da. 1984. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. File Number DE86702106.

In Annual technical report of Nuclear Engineering Institute - Physics Department - 1984.

6520 Nuclear Properties And Reactions, A=220 And Above, Theoretical

REFER ALSO TO CITATION(S) 35132, 35133, 35158, 35159, 35160

35158 (ENEA-RT/FIMA—82-5) **Evaluation of ^{246}Cm neutron cross sections from 10^{-5} eV to 15 MeV.** Maino, G.; Menapace, E.; Vaccari, M.; Ventura, A. (ENEA, Bologna (Italy). Dipartimento Tecnologie Intersettoriali di Base). 1982. 47p. (INDC(ITY)—8). NTIS (US Sales Only), PC A03/MF A01. File Number DE86901370.

After a short review of the experimental data deemed most important Curium 246 neutron cross sections are evaluated. This evaluation involves calculations in the resolved resonance region (≦390 eV), the unresolved resonance (390 eV to 10 KeV), and the continuum region (10 KeV to 15 MeV). Evaluations are made of total, elastic, capture, radiative, fission, integral, and differential cross sections. 38 refs., 13 figs., 12 tabs. (DWL)

35159 (ENEA-RT/FIMA—82-6) **Evaluation of ^{242}Cm neutron cross sections from 10^{-5} eV to 15 MeV.** Maino, G.; Menapace, E.; Motta, M.; Vaccari, M. (ENEA, Bologna (Italy). Dipartimento Tecnologie Intersettoriali di Base). 1982. 43p. (INDC(ITY)—7). NTIS (US Sales Only), PC A03/MF A01. File Number DE86901371.

After a short review of experimental data deemed most important, Curium 242 neutron cross sections are evaluated. This evaluation involves calculations in the resonance region (10^{-5} eV to 280 eV), the unresolved resonance region (280 eV to 10 KeV), and the continuum region (10 KeV to 15 MeV). Evaluations are made of total, elastic, capture, radiative, fission, integral, and differential cross sections. 21 refs., 19 figs., 7 tabs. (DWL)

35160 (ENEA-RT/FIMA—82-7) **Evaluation of Cm-247 neutron cross sections from 10^{-5} eV to 15 MeV.** Maino, G.; Menapace, E.; Vaccari, M.; Ventura, A. (ENEA, Bologna (Italy). Dipartimento Tecnologie Intersettoriali di Base). 1982. 36p. (INDC(ITY)—9). NTIS (US Sales Only), PC A03/MF A01. File Number DE86901372.

After a short review of experimental data deemed most important Curium 247 neutron cross sections are evaluated. This evaluation involves calculations in the resonance region (1 eV to 61 eV), the unresolved region (61 eV to 10 KeV) and the continuum region (10 KeV-15 MeV). Evaluations are made of total, elastic, radiative, fission, integral, and differential cross sections. 25 refs., 13 figs., 9 tabs. (DWL)

35161 (FEI—1588) **Unitary scheme for construction of cross sections in a resonance region.** Kolesov, V.V.; Luk'yanov, A.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1984. 13p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE86702146.

Proceeding from the unitarity property of collision matrix obtained are relations between resonance parameters of different reaction cross-sections in S matrix theory formalism. The neutron absorption resonance cross section for sup(239)Pu describing well direct measurement results in the range below 100 eV was constructed using results of multilevel analysis of total cross section. The suggested scheme with the unitarity conservation appears more strict in the task of the exact reproduction according to the parameters of resonance cross section of elsastic scattering.

35162 (INIS-BR—461, pp 30-32) **Yield determination and fission products decay scheme in the actinide fission induced by charged particles.** Bellido, A.V.; Cabral, S.C. 1984. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. File Number DE86702106.

In Annual technical report of Nuclear Engineering Institute - Physics Department - 1984.

35163 (UCRL—94606) **Discovery of a new mode of nuclear fission.** Hulet, E.K.; Wild, J.F.; Dougan, R.J.; Loughead, R.W.; Landrum, J.H.; Dougan, A.D.; Schaedel, M.; Hahn, R.L.; Baisden, P.A.; Henderson, C.M. (Lawrence Livermore National Lab., CA (USA)). 1986. Contract W-7405-ENG-48. 8p. (CONF-8604165—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010983.

From International conference on heavy ion physics; Rochester, NY, USA (21 Apr 1986).

We measured the mass and kinetic-energy partitioning in the spontaneous fission of ^{258}Fm, ^{260}Md, ^{260}Md, ^{256}No, and ^{260}[104]. Surprisingly, these energy distributions were skewed upward or downward from the peak in each case, except for ^{260}[104], indicating a composite of two energy distributions. We interpret this as a new mode of fission in which there is mixture of liquid-drop-like and fragment-shell-directed symmetric fission.

35164 **Fast neutron ineleastic scattering cross sections of ^{238}U for states between 680 and 1530 keV.** Shao, J.Q.; Couchell, G.P.; Egan, J.J.; Kegel, G.H.R.; Li, S.Q.; Mittler, A.; Pullen, D.J.; Schier, W.A.; Arthur, E.D. (University of Lowell, Department of Physics and Applied Physics, Lowell, MA 01854). *Nuclear Science and Engineering;* **92**: No. 3, vp(Mar 1986).

Neutron inelastic scattering cross sections for ^{238}U levels between 680- and 1530-keV excitation energy have been measured in the incident neutron energy range from 0.9 to 2.2 MeV. The (n,n') time-of-flight (TOF) technique was used to obtain direct differential inelastic cross sections. Neutrons were generated using the ^{7}Li(p,n)^{7}Be reaction. Experimental parameters were optimized to achieve an energy resolution of $<$15 keV. Level cross sections were deduced from the measured 125-deg differential scattering cross sections. The validity of this procedure was confirmed by measuring the angular distributions for nine levels at En=1.5 and 2.0 MeV. Background due to fission induced by fast neutrons was subtracted. The TOF spectra were unfolded using the method of the response function. The data were corrected for multiple scattering and neutron attenuation in disk scattering geometry using an analytic method. Theoretical calculations of the cross sections were carried out using reaction models appropriate to the description of compound nucleus and direct interaction processes. The data are compared to (n,n'γ) results and the ENDF/B-V evaluation.

6530 Nuclear Theory

35165 **(ITEP—33(1984)) Cumulative processes and quark distribution in nuclei.** Kondratyuk, L.; Shmatikov, M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki; Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1984. 40p. NTIS (US Sales Only), PC A03/MF A01. File Number DE86702147.

Assuming existence of multiquark (mainly 12q) bags in nuclei the spectra of cumulative nucleons and mesons produced in high-energy particle-nucleus collisions are discussed. The exponential form of quark momentum distribution in 12q-bag (agreeing well with the experimental data on lepton-nucleus interactions at large q^2) is shown to result in quasi-exponential distribution of cumulative particles over the light-cone variable αsub(B). The dependence of f(αsub(B); psub(perpendicular)) (where psub(perpendicular) is the transverse momentum of the bag) upon psub(perpendicular) is considered. The yields of cumulative resonances as well as effects related to the u- and d-quark distributions in N $>$ Z nuclei being different are dicscussed.

35166 **(ITEP—59(1984)) Dynamical breaking of colour symmetry in SUSY Yang-Mills theories with matter.** Novikov, V.A.; Shifman, M.A.; Vainshtein, A.I.; Zakharov, V.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1984. 9p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86702112.

SUSY theories which spontaneously break colour in the weak coupling regime are considered. The clustering of correlator functions dominated by small-size instantons is explicitly confirmed. This completes the proof of spontaneous SUSY breaking in some of the models (with chiral matter) presented earlier in the literature. Moreover, in some limiting cases both SUSY and colour breakings occur when the effective coupling constant is arbitrarily small and all the calculations are under control. Some of the properties of such theories are discussed.

35167 **(ITEP—61(1985)) Model of homogeneous nucleus. Total and inelastic cross sections of nucleon-nucleus scattering.** Ponomarev, L.A.; Smorodinskaya, N.Ya. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1985. 16p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86702148.

It is shown that the nucleon-nucleus scattering amplitude at high energy can be easily calculated by generalization of the nucleon-nucleon scattering amplitude and satisfies a simple factorization relation. As distinct from the Glauber model, the suggested approach makes no use of the nucleonic structure of the nucleus and the hadron-nucleus scattering amplitude is not expressed in terms of hadron-nucleon scattering amplitudes. The energy dependence of total and inelastic cross sections is successfully described for a number of nuclei.

35168 **(JINR—E-4-85-352) Strength functions of high-lying single-neutron states.** Vdovin, A.I.; Stoyanov, Ch. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1985. 11p. (CONF-850635—). NTIS (US Sales Only), PC A02/MF A01. File Number DE86702144.

From 4. international symposium on neutron induced reactions; Smolenice, Czechoslovakia (17 Jun 1985).

Strength functions of single-neutron states with excitation energy from 7 to 12 MeV in ^{91}Zr, sup(117,121)Sn, sup(145)Sm, and sup(209)Pb nuclei are calculated. The quasiparticle-phonon nuclear model and strength function method are used. The results of calculations are compared with available experimental data for tin isotopes.

35169 **(KFKI—1986-05/A) Quark degrees of freedom in nuclei.** Lovas, I. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). 1986. 26p. (CONF-8506278—2). NTIS (US Sales Only), PC A03/MF A01. File Number DE86901312.

From 10. European symposium on the dynamics of few-body systems; Balatonfured, Hungary (3 Jun 1985).

Experimental facts which cannot be interpreted in terms of nucleonic degrees of freedom are reviewed. Attempts to explain these observations by the help of the notions of quark physics are indicated. Some predicted exotic states are enumerated. The most promising models of the nucleon-nucleon interactions in terms of quarks are briefly discussed.

6540 Radiation And Shielding Physics

REFER ALSO TO CITATION(S) 34076, 34077, 35374, 35374

35170 **(AD-A—164523/3/XAB) Study of off-axis radiation exposure from relativistic electrons traversing through matter. Master's thesis.** Fitzpatrick, R.D. (Naval Postgraduate School, Monterey, CA (USA)). Dec 1985. 144p. NTIS, PC A07/MF A01.

Results are presented from the study of the off-axis radiation field caused by a relativistic, mono-directional electron beam passing through water. Using the Naval Postgraduate School 100-MeV linear accelerator, off-axis radiation dose was measured with calcium fluoride thermoluminescent dosimeters placed at various path lengths out to two radiation lengths. The off-axis dose was calculated using the electron transport code CYLTRAN of the integrated TIGER series of coupled electron/photon Monte Carlo transport codes. Calculations were performed at Los Alamos National Laboratory. Comparison with the results is made and CYLTRAN is found to be in agreement with experimentally measured values. The extension of results from one medium(water) to another (air) appears to be valid.

35171 **(AD-A—955044/3/XAB) Multiple Compton scattering of low-energy gamma radiation.** O'Rourke, R.C. (Naval Research Lab., Washington, DC (USA)). 1 Mar 1953. 6p. (NRL-REPRINT—24-53). NTIS, PC A02/MF A01.

The exact problem of multiple Compton scattering in an infinite plane parallel medium is set up for a monochromatic primary spectral distribution normally incident upon a semi-infinite medium for isotropic scattering. It is treated by a different approach to that previously used by the author, the new approach being based in part on Marshak's method of spherical harmonics. Numerical results are presented for the P1 approximation to this problem. This result is compared with the corresponding solution obtained previously. The present method shows that the broadening is not as severe as the previous method had indicated.

35172 (EML—447) **Cosmic-ray hadrons underground.** O'Brien, K. (Department of Energy, New York (USA). Environmental Measurements Lab.). Dec 1985. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011334.

Hadron fluxes and star densities in volcanic material have been calculated down to a depth of 6000 g/cm^3 to supply a data base for use in calculating cosmogenic isotopes production. It is hoped to be able to use these isotopes to determine the age of the volcanic material. Some curves of star density with depth and of hadron spectra for various depths in basalt are presented. 7 refs., 9 figs., 2 tabs.

35173 (INIS-BR—462, pp 382-386) **Synchrotron radiation: characteristics and application in structural studies and phase transformations of materials.** Craievich, A.F. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1984. (In Portuguese). NTIS (US Sales Only), PC A17/MF A01. File Number DE86702009. (CONF-8412102—).

From 6. Brazilian congress on engineering and materials science; Rio de Janeiro, Brazil (9 Dec 1984).

The main characteristics of the synchrotron radiation for studying atomic structure and phase transformations in materials are presented. Some specific applications in alloys, glass and solids are described.

35174 (INIS-mf—10105, pp 93) **ESR study of radiation defects in silicon for semiconductor devices.** Prasil, Z. (Ustav pro Vyzkum, Vyrobu a Vyuziti Radioisotopu, Prague, Czechoslovakia). 1984. NTIS (US Sales Only), PC A02/MF A01. File Number DE86702155. (CONF-8406249—Vol.2-Absts.).

From 7. Czechoslovak spectroscopic conference and 8. CANAS; Ceske Budejovice, Czechoslovkia (18 Jun 1984).

35175 (INIS-mf—10110, pp 13-27) **Gamma radiation transport and scattering in layers of material.** Seda, J. (Ceske Vysoke Uceni Technicke, Prague, Czechoslovakia. Fakulta Jaderna a Fysikalne Inzenyrska). 1982. (In Czech). NTIS (US Sales Only), PC A04/MF A01. File Number DE86701972. (CONF-8209296—).

From Conference on application of Monte Carlo method in modelling physical and physico-chemical processes; Prague, Czechoslovakia (9 Sep 1982).

A program was written to allow modelling, using the Monte Carlo method, gamma radiation transport through homogeneous and heterogeneous material under given geometrical conditions. Modelling all basic types of interactions it was found that coherent scattering has great influence on the value of albedo. Further computations showed that the dependence on atomic number Z of the probability of impingement of backscattered photons on the detector, is a complicated curve with maxima in every group of the periodical table. The shape of the curve is influenced by the dependence of albedo on Z. The said program was used to compute the probability of gamma backscattering from layers of material with a thickness less than the saturation thickness. Also computed were the values of gamma radiation buildup factors, and the configuration was designed for measuring material density using gamma radiation backscattering under different measuring conditions.

35176 (ORNL/TM—8629) **Development of simplified methods and data bases for radiation shielding calculations for concrete.** Bhuiyan, S.I.; Roussin, R.W.; Lucius, J.L.; Marable, J.H.; Bartine, D.A. (Oak Ridge National Lab., TN (USA)). Jun 1986. Contract AC05-84OR21400. 139p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE86011349.

Two simplified methods have been developed which allow rapid and accurate calculations of the attenuation of neutrons and gamma rays through concrete shields. One method, called the BEST method, uses sensitivity coefficients to predict changes in the transmitted dose from a fission source that are due to changes in the composition of the shield. The other method uses transmission factors based on adjoint calculations to predict the transmitted dose from an arbitrary source incident on a given shield. The BEST method, utilizing an exponential molecule that is shown to be a significant improvement over the traditional linear model, has been successfully applied to slab shields of standard concrete and rebar concrete. It has also been tested for a special concrete that has been used in many shielding experiments at the ORNL Tower Shielding Facility, as well as for a deep-penetration sodium problem. A comprehensive data base of concrete sensitivity coefficients generated as part of this study is available for use in the BEST model. For problems in which the changes are energy independent, application of the model and data base can be accomplished with a desk calculator. Larger-scale calculations required for problems that are energy dependent are facilitated by employing a simple computer code, which is included, together with the data base and other calculational aids, in a data package that can be obtained from the ORNL Radiation Shielding Information Center (request DLC-102/CONSENT). The transmission factors used by the second method are a byproduct of the sensitivity calculations and are mathematically equivalent to the surface adjoint function phi*, which gives the dose equivalent transmitted through a slab of thickness T due to one particle incident on the surface in the gth energy group and jth direction. 18 refs., 1 fig., 50 tabs.

35177 (PB—86-141934/XAB) **Angular distribution of high-energy electrons following radiation.** Maximon, L.C.; Lepretre, A. (National Bureau of Standards, Washington, DC (USA). Center for Radiation Research). Oct 1985. 53p. (NBSIR—84/2854). NTIS, PC A04/MF A01.

An expression is derived for the angular distribution of high-energy electrons that have undergone scattering and radiated a photon, integrated over the directions of the emitted photon, in the region of small scattering angles, for which the atomic form factor must be taken into account but the nuclear structure may be neglected. This distribution is analogous to Schiff's high-energy small-angle distribution for photons, integrated over the final electron angles. It is shown that the correction to the energy-angle distribution of electrons due to atomic screening is identical in form to the correction to the energy-angle distribution of photons. This correction involves an integral over the atomic form factor, and is evaluated in closed form for the Thomas-Fermi-Moliere model. A very simple expression is obtained for the case of complete screening.

35178 **Impact of ^{57}Fe on neutron penetration in thick sodium-iron shields.** Fu, C.Y.; Ingersoll, D.T. (Oak Ridge National Lab., TN). *Transactions of the American Nuclear Society;* **50**: 470-472(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

On the basis of this analysis, the following conclusions can be drawn: 1. In neutron penetration calculations through thick steel regions, ^{57}Fe can be ten times more important than is indicated by its isotopic abundance in natural iron. 2. The 14.4-keV inelastic level of ^{57}Fe is sufficiently important that it may be worthwhile to perform a measurement of this cross section to validate the ENF/B-V MOD-3 value, which was obtained from nuclear model calculations. 3. Shielding analyses done with iron cross sections predating ENDF/B-V MOD-3 should be reviewed and may need to be revised. The general lesson learned here is that inelastic scattering cross sections of minor isotopes may not have a negligible impact, especially if their energy levels are lower than those of the major isotopes, and therefore they should be included in cross section evaluations.

35179 **Analysis of the TORT validation experiment.** Rhoades, W.A.; Childs, R.L.; Ingersoll, D.T.; Muckenthaler, F.J. (Oak Ridge National Lab., TN). *Transactions of the American Nuclear Society;* **50**: 473-475(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

In a previous paper, calculations of a hypothetical concrete building by various discrete ordinates formulations and by Monte Carlo were compared. In general, agreement was good in areas directly affected by the source, but in areas completely shaded from the source by structural details, discrete ordinates showed more flux than did Monte Carlo. More recently, a model building has now been constructed and irradiated at the ORNL Tower Shielding Facility, allowing direct measurement of fluxes within the structure. The building calculations were performed with ORNL's three-dimensional discrete ordinates code, TORT, together with a

37-neutron, 21-gamma-group P_3 cross-section library derived from the VITAMIN-E cross section set. The validation experiment has supplied considerable insight into the strengths and weaknesses of three-dimensional discrete ordinates methods for such applications.

35180 **Method for coupling two-dimensional to three-dimensional discrete ordinates calculations.** Thompson, J.L.; Emmett, M.B.; Rhoades, W.A.; Dodds, H.L. Jr. (Univ. of Tennessee, Knoxville). *Transactions of the American Nuclear Society;* **50**: 475-476(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

A three-dimensional (3-D) discrete ordinates transport code, TORT, has been developed at the Oak Ridge National Laboratory for radiation penetration studies. It is not feasible to solve some 3-D penetration problems with TORT, such as a building located a large distance from a point source, because (a) the discretized 3-D problem is simply too big to fit on the computer or (b) the computing time (and corresponding cost) is prohibitive. Fortunately, such problems can be solved with a hybrid approach by coupling a two-dimensional (2-D) description of the point source, which is assumed to be azimuthally symmetric, to a 3-D description of the building, the region of interest. The purpose of this paper is to describe this hybrid methodology along with its implementation and evaluation in the DOTTOR (Discrete Ordinates to Three-dimensional Oak Ridge Transport) code.

35181 **Extension of the linear nodal method to large concrete building calculations.** Childs, R.L.; Rhoades, W.A. (Oak Ridge National Lab., TN). *Transactions of the American Nuclear Society;* **50**: 476-477(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

Studies of radiation penetration into large concrete and masonry structures are in progress at Oak Ridge National Laboratory. Accomplishments to date include the development of TORT, a three-dimensional (3-D) extension of the DOT discrete ordinates transport code, and the completion of an experiment at the Tower Shielding Facility for methods testing purposes. In this paper, the implementation of the linear nodal method in the TORT code is described, and the results of a mesh refinement study to test the effectiveness of the linear nodal and weighted diamond-difference methods available in TORT are presented.

6550 Medical Physics

REFER ALSO TO CITATION(S) 35384

35182 **(DOE/OR/00033—T175) Microdosimetric system for use in the measurement of specific energy distributions for 15 MeV electrons in water.** Hamby, D.M. (North Carolina Univ., Chapel Hill (USA). Dept. of Environmental Sciences and Engineering). 1986. Contract AC05-76OR00033. 94p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86010836.

A spherical, solid-walled, tissue equivalent proportional counter has been used to obtain specific energy distributions for 15 MeV electrons. The microdosimetric proportional counting system is new to the university with initial measurements being obtained in the Department of Radiation Therapy at the North Carolina Memorial Hospital. Specific energy distributions as functions of dose, f(z,D), at various depths in water have been recorded using the therapeutic electron accelerator. Plots are presented showing the experimentally measured relationship between distribution variances and dose for 1 micron spheres of simulated tissue. The mean of the distribution, anti z, as a function of depth in water has also been determined.

35183 **(KAERI/MR—78/84, pp 1-85) Radiological safety control and safeguards (KAERI-Daeduk).** Ha, C.W.; Hong, C.S.; Suh, K.W.; Chang, S.Y.; Lee, T.Y.; Han, S.J.; Yun, E.C. (Korea Advanced Energy Research Inst., Daeduk, Republic of Korea). Mar 1985. (In Korean). NTIS (US Sales Only), PC A08/MF A01. File Number DE86780464.

In Radiological safety and control.

In 1984, radiological safety control and safeguards had been carried out in KAERI-Daeduk headquarter and KAERI-Seoul branch and the results were achieved with good satisfaction. The objective of radiological safety control lie in justifying the radiation exposure and and optimizing the radiation protection through protecting the occurrence of non-stochastic acute effects due to radiation exposure and limiting the probability of occurrence of chronic and genetic effects to the permissible level with the basic of ALARA (As Low As Reasonably Achievable) concepts. Safeguards were also carried out for peaceful use of the atomic energy in compliance with the international treaty.

35184 **(KAERI/MR—78/84, pp 87-142) Radiological safety control and safeguards (KAERI-Seoul).** Ha, C.W.; Lee, H.D.; Lee, K.C.; Lee, B.J.; Kim, C.K. (Korea Advanced Energy Research Inst., Daeduk, Republic of Korea). Mar 1985. (In Korean). NTIS (US Sales Only), PC A08/MF A01. File Number DE86780464.

In Radiological safety and control.

The work system to achieve these objectives is composed of 5 different areas: radiation area monitoring, personnel radiation exposure control, environmental radiation and radioactivity monitoring, calibration of radiation monitoring instruments and safeguards. The calibration, maintenance and repair of radiation monitoring instruments are some of the most important work in performing the radiological safety control and have the objectives of increasing the degree of precision and reliablity for the detected value. Major work performed in safeguards were control of nuclear materials accountability, inventory change, material balance, recording and keeping the transfer of nuclear material balance areas (MBAs), physical inventory taking (PIT) and reporting to IAEA.

35185 **(KAERI/MR—82/84) Radionuclide analysis.** Park, C.G.; Kim, N.B.; Cho, Y.U.; Han, M.J.; Lee, M.H.; Lee, G.Y. (Korea Advanced Energy Research Inst., Daeduk (Republic of Korea)). Mar 1985. 127p. (In Korean). NTIS (US Sales Only), PC A07/MF A01. File Number DE86702171.

To control and predict the internal contamination in human body by radioactive material, measurements of radionuclides in foodstuffs were carried out. These results can be used for monitoring the internal exposure of the general population and the accumulation pattern estimated of radioactive materials in the environment. In addition, measurements which were made for both radiations and radionuclides of all environmental samples submitted from the nuclear power plants are necessary as the reference data between pre or post-operation plants and as the reference data for use in quality control at Kori No. 1, No. 2 and Wolsung power plant in operation. As neutron activation analysis is developed to a method capable for multielement determination, treatment of a corresponding number of standards appears obviously not to be simple task. Different approches such as relative method, and absolute method (the use of a comparator) are presented and evaluated critically in order to put them into common formulation.

35186 **(NRL—1984/1) Natural radioactivity of building materials used in the Christchurch urban area.** Chapman, R.H. (National Radiation Lab., Christchurch (New Zealand)). 1984. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86702170.

The natural gamma radioactivity of a variety of common building materials in Christchurch has been measured by gamma spectroscopy. Using conversion factors from the literature, relative dose rate indices for the various building materials were calculated and compared. An increasing order of radioactivity concentration was found from timber to compressed limestone to brick products. These levels are however less than the acceptable limits of radioactivity based on some overseas criteria suggested as building standards.

35187 **(SBD—4889) Radiation doses from radioactivity in incandescent mantles.** (Technische Hogeschool Eindhoven (Netherlands). Stralingsbeschermingsdienst). Jan 1985. 16p. (In Dutch). NTIS (US Sales Only), PC A02/MF A01. File Number DE86702175.

Thorium nitrate is used in the production of incandescent mantles for gas lanterns. In this report dose estimates are given for internal and external exposure that result from the use of the incandescent mantles for gas lanterns. The collective, effective dose equivalent for all users of gas mantles is estimated to be about 100 Sv per annum in the Netherlands. For the population involved (ca. 700,000 persons) this is roughly equivalent to 5% to 10% of the collective dose equivalent associated with exposure to radiation from natural sources. The major contribution to dose estimates comes from inhalation of radium during burning of the mantles. A pessimistic approach results in individual dose estimates for inhalation of up to 0.2 mSv. Consideration of dose consequences in case of a fire in a storage department learns that it is necessary for emergency personnel to wear respirators. It is concluded that the uncontrolled removal of used gas mantles to the environment (soil) does not result in a significant contribution to environmental radiation exposure.

35188 **Value of some estimations in radiation protection.** Courtney, J.C.; Williams, M.L. (Louisiana State Univ., Baton Rouge). *Transactions of the American Nuclear Society;* 50: 443-444(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

Many problems in radiation protection require the use of sophisticated techniques for their solution. However, a large class of problems, particularly in the area of operations, can be addressed with suitable accuracy using approximate techniques. Approximate methods and extrapolation of empirical data can serve to scope the magnitude of a variety of problems. In fact, the authors believe that these approaches should be a necessary first step in determining what additional, more sophisticated analyses are required. To assist in radiation protection analyses, the authors have developed a series of microcomputer programs based on approximate methods. In addition to implementing approaches developed over the last 30 yr, they are continuously reviewing the literature for useful techniques and data. As they compare results to other predictions and to measurements, confidence in practical, simplified approaches to a variety of radiation protection problems is increased.

6560 Solid-state Physics

REFER ALSO TO CITATION(S) 34701

35189 **Ideal thermal conductivity of Pd and Nb.** Pinski, F.J.; Butler, W.H.; Allen, P.B. (Oak Ridge National Lab., TN). pp 155-163 of Thermal conductivity 16. Larsen, D.C. (ed.). New York, NY; Plenum Publishing Corporation (1983). Contract W-7405-ENG-26.

The authors have calculated the electron-phonon contribution to the thermal conductivity of Pd and Nb. The Boltzmann equation describes the electronic distribution function in the presence of a thermal gradient. The authors solved the Boltzmann equation within the rigid-muffin-tin approximation, using a very dense mesh of first-principles, Korringa-Kohn-Rostoker wave vectors on the Fermi surface. Phonon frequencies and polarizations were obtained from Born-von Karman force-constant fits of neutron scattering data. The electron-phonon matrix elements were calculated by using the rigid-muffin-tin approximation. The calculation is free of adjustable parameters. Agreement with experiment is at the 15% level at room temperature. 19 references, 2 figures.

6561 Superconductivity

REFER ALSO TO CITATION(S) 34271, 34315

6570 Theoretical Physics

REFER ALSO TO CITATION(S) 35096, 35385

35190 **(AD-A—163839/4/XAB) Quantum-mechanical atomic energy operator. Master's thesis.** (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Dec 1984. 75p. (AFIT/GEP/PH—84D-13). NTIS, PC A04/MF A01.

Various forms of the atomic Hamiltonian are examined as the energy operator for an atom in an electromagnetic field, using the semiclassical approach. The unperturbed Hamiltonian and the full atomic Hamiltonian have been favorite choices in the past, but these give different predictions if treated as the energy operator. The A dot p versus r dot e controversy is also examined and clarified. Both choices have conflicts with observations or physical laws. Gauge invariance and the Stark effect are considered. The multipole Hamiltonian is presented and argued as the correct energy operator. Calculations for three photon absorption in a two level atom, using time dependent perturbation theory, yield significant differences in the predictions for absorption rate and resonant frequency.

35191 **(AD-A—164054/9/XAB) Estimation theory and statistical physics. Technical paper.** Mitter, S.K. (Massachusetts Inst. of Tech., Cambridge (USA). Lab. for Information and Decision Systems). Dec 1985. 22p. (LIDS-P—1518). NTIS, PC A02/MF A01.

The construction of a nonlinear filter involves an integration over function space which is exactly analogous to the construction of a measure on path space via the Feynman-Kac-Nelson formula. In Kalman-Bucy filtering problem the filtering of Gauss-Markov processes in the presence of additive white Gaussian noise occupies the same role as the Ornstein-Uhlenbeck process (finite or infinite-dimensional) in quantum mechanics or quantum field theory. That this analogy is borne out by the fact that a solvable Lie algebra, the oscillator algebra which contains the Heisenberg algebra as a derived algebra is intrinsically attached to the Kalman-Bucy filtering problem. The problem of nonlinear filtering of diffusion processes was shown to admit a stochastic variational interpretation. The objective of this paper is to strengthen these analogies further with a view to showing the close relationship of estimation theory to statistical mechanics. The motivation for this comes from problems of estimation and inverse problems related to image processing. In order to carry out this program it is necessary to generalize these ideas to filtering problems for infinite-dimensional processes. There are two types of processes involved: continuous processes such as infinite-dimensional Ornstein-Uhlenbeck processes and their L2-functionals which represent intensities of images and processes of a discrete nature which will represent boundaries of images. The most interesting models are obtained when these processes are coupled according to a probabilistic mechanisms. The discrete processes should be thought of as gauge fields and will be a process on connection forms.

35192 **(FNAL/Pub—86/60-A) Geometrical properties of an internal local octonionic space in curved space time.** Marques, S.; Oliveira, C.G. (Fermi National Accelerator Lab., Batavia, IL (USA); Brasilia Univ. (Brazil). Dept. de Fisica). Apr 1986. Contract AC02-76CH03000. 27p. NTIS, PC A03/01; 1; GPO Dep. File Number DE86011023.

A geometrical treatment on a flat tangent space local to a generalized complex, quaternionic, and octonionic space-time is constructed. It is shown that it is possible to find an Einstein-Maxwell-Yang-Mills correspondence in this generalized (Minkowskian) tangent space. 9 refs.

35193 (INIS-SU—321, pp 356-372) **General properties of algebraic gauges.** Bassetto, A. 1984. NTIS (US Sales Only), PC A19/MF A01. File Number DE86780458. (CONF-8407160—Vol.1).

From 7. seminar on problems of high energy physics and quantum field theory; Protvino, USSR (1 Jul 1984).

A pure Yang-Mills theory with the Lagrangian density $L=1/4\ Gsub(\mu\nu)sup(\alpha)\ Gsup(\alpha\mu\pi)$, $a=1,\ N^2-1$ is considered. Path-integral formalism is derived for the spacelike planar gauge from a hamiltonian formulation in which the structure of the physical Hilbert space and the meaning of the spurious singularity have been fully clarified and understood.

35194 (INIS-SU—321, pp 85-98) **Coordinates in relativistic hamiltonian mechanics.** Sokolov, S.N. 1984. NTIS (US Sales Only), PC A19/MF A01. File Number DE86780458. (CONF-8407160—Vol.1).

From 7. seminar on problems of high energy physics and quantum field theory; Protvino, USSR (1 Jul 1984).

A systematic analysis of the space-time interpretation of relativistic Hamiltonian mechanics for the case of two particles is carried out. The analysis confirms qualitatively the spatial interpretation of the relativistic Hamiltonian formalism. The analysis makes some corrections: it shows that canonical coordinates of the center-of-inertia are noncovariant and therefore must be distinguished from the physical ones. The noncovariance is shown to be overcome, since in the point form of dynamics particles have covariant coordinates and the equations of motion may be cast into an explicitly covariant form.

35195 (INIS-SU—321, pp 99-122) **Relativistic Lagrangian mechanics and other approaches in the direct interaction theory.** Gaida, R.P.; Kluchkovsky, Yu.B.; Tretyak, V.I. (AN Ukrainskoj SSR, Lvov. Inst. Prikladnykh Problem Mekhaniki i Matematiki). 1984. NTIS (US Sales Only), PC A19/MF A01. File Number DE86780458. (CONF-8407160—Vol.1).

From 7. seminar on problems of high energy physics and quantum field theory; Protvino, USSR (1 Jul 1984).

Three-dimensional Lagrangian formalism is shown to be the most convenient method for considering general problems of classical relativistic direct interaction theory (RDIT). It makes use of the covariant particle coordinates having clear geometric meaning of the Minkowski space. It also makes it possible to modify the RDIT for accounting for an external field (an electromagnetic one). One more advantage of the Lagrangian relativistic mechanics is the applicability of the standard method for obtaining the conserved quantities. A method of finding general solutions of the Poincare invariance conditions is developed for using linear superposition of interactions.

35196 (INIS-SU—321, pp 123-168) **From relativistic mechanics toward Green's functions. Multitemporal dynamics.** Luca Lusanna. 1984. NTIS (US Sales Only), PC A19/MF A01. File Number DE86780458. (CONF-8407160—Vol.1).

From 7. seminar on problems of high energy physics and quantum field theory; Protvino, USSR (1 Jul 1984).

The gauge structure inherent to models with first-class constraints is displayed and various other connected approaches to relativistic mechanics are reviewed. The relations among the various kinds of coordinates are elucidated and a unified theory is beginning to emerge. As the quantization of relativistic 2-body systems is far from trivial, nonrelativistic 2-body Newton theory is reformulated as a theory with first-class constraints. For the harmonic oscillator the Todorov-Komar singular Lagrangian, the predictive accelerations and their interpretation are given. The first-class constraints are then quantized without gauge fixing. The role of actions defined along lines in the (t_1, t_2)-plane is elucidated and the scalar product is found. A probabilistic interpretation of the two-particle wave function is given which resolves the relative time problem. As an application to nonrelativistic quantum field theory two first-class constraints, quasi-potential approach, are found as a classical basis of the non-relativistic Bethe-Salpeter equation.

35197 (INIS-SU—321, pp 169-180) **Singular Lagrangians and three-dimensional description of a two-particle system.** Klyuchkovskij, Yu.B.; Duviryak, A.A. (AN Ukrainskoj SSR, Lvov. Inst. Prikladnykh Problem Mekhaniki i Matematiki). 1984. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE86780458. (CONF-8407160—Vol.1).

From 7. seminar on problems of high energy physics and quantum field theory; Protvino, USSR (1 Jul 1984).

Some methods of representation of DGL (dynamic gauge lagrangian) models of singular Lagrangian formalism in the three-dimensional form are presented. The introduction of Yukawa-Markov dynamics form is the main factor. Exact equations of motion for DGL models and their motion integrals are obtained. The method proposed permits finding a Lagrange function in any approximation in terms of the C^{-2} parameter. Two ways of the transition to instant dynamics form are described.

35198 (INIS-SU—321, pp 192-212) **Application of homogeneous formalism in nonrelativistic quantum mechanics.** Razumov, A.V.; Taranov, A.Yu. 1984. NTIS (US Sales Only), PC A19/MF A01. File Number DE86780458. (CONF-8407160—Vol.1).

From 7. seminar on problems of high energy physics and quantum field theory; Protvino, USSR (1 Jul 1984).

The description of a nonrelativistic particle in a potential field is given in the framework of homogeneous formalism. The correspondence is established between homogeneous and conventional formalisms, which allows solving the problems concerned with relations which may be used in quantizing other systems, invariant under the choice of the evolution parameter.

35199 (INIS-SU—321, pp 213-228) **Some properties of constraints in theories with degenerate Lagrangians.** Nesterenko, V.V.; Chervyakov, A.M. (Joint Inst. for Nuclear Research, Dubna, USSR). 1984. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE86780458. (CONF-8407160—Vol.1).

From 7. seminar on problems of high energy physics and quantum field theory; Protvino, USSR (1 Jul 1984).

Using the second Noether theorem, it is shown that the invariance of the action under transformations with arbitrary time functions leads to primary constraints which, at least, are in weak evolution. It is proved that Lagrangian constraints are invariant relations for Euler equations. The criterion of the existence in the theory of secondary constraints is proposed in the light of Lagrangian formalism. Poisson brackets of primary constraints with canonical Hamiltonians are calculated.

35200 (INIS-SU—321, pp 229-236) **Exactly soluble three-dimensional model of a relativistic harmonic oscillator.** Atakishiev, N.M.; Nagiev, Sh.M.; Mir-Kasimov, R.M. (AN Azerbajdzhanskoj SSR, Baku. Inst. Fiziki; Joint Inst. for Nuclear Research, Dubna, USSR). 1984. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE86780458. (CONF-8407160—Vol.1).

From 7. seminar on problems of high energy physics and quantum field theory; Protvino, USSR (1 Jul 1984).

This work is aimed at summing up the results of the investigation of the equation generalizing the three-dimensional probiem of a harmonic oscillator for a relativistic case. The description is based on the quasipotential approach. The investigated three-dimensional model of a harmonic oscillator is formulated in relativistic r vector configurational presentation where the Hamiltonian is a finite-differential operator with U(3)-symmetry. The explicit form of wave functions in the spherical system of coordinates is found. Orthogonality conditions, generating function and different recurrent relations for the radial part of the wave function are obtained. Operators increasing and decreasing orbital quantum number "l" are determined and symmetry dynamic group is constructed using Infield-Wall factorization method.

35201 (INIS-SU—321, pp 3-10) **Minkowski space as the basis of physical theory of gravitation.** Logunov, A.A.; Vlasov, A.A. (Moskovskij Gosudarstvennyj Univ., USSR). 1984. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE86780458. (CONF-8407160—Vol.1).

From 7. seminar on problems of high energy physics and quantum field theory; Protvino, USSR (1 Jul 1984).

A new variant of gravity theory with non-complete geometrization of gravitational field Lagrangian density is considered. Nonlinear equations for a free gravitational field not exceeding the second order are investigated. The investigation is carried out in Minkowski space in Galilean coordinates. In arbitrary coordinates of Minkowski space Lagrangian density is solar density of weight + 1 in contrast to general relativity theory.

35202 (INIS-SU—321, pp 11-18) **Spherically-symmetric solution in gravity theory based on Minkowski space.** Logunov, A.A.; Vlasov, A.A. (Moskovskij Gosudarstvennyj Univ., USSR). 1984. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE86780458. (CONF-8407160—Vol.1).

From 7. seminar on problems of high energy physics and quantum field theory; Protvino, USSR (1 Jul 1984).

The consideration of the new variant of gravitation theory with non-complete geometrization of gravitational field Lagrangian is continued. Coordinate conditions in the proposed approach are specified by the metric tensor of Minkowski space. It is shown that for a static spherically symmetrical body the inert mass equals its gravitating mass.

35203 (INIS-SU—321, pp 24-47) **Relativistic gravity theory.** Logunov, A.A.; Mestvirishvili, M.A. 1984. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE86780458. (CONF-8407160—Vol.1).

From 7. seminar on problems of high energy physics and quantum field theory; Protvino, USSR (1 Jul 1984).

Results of the previous investigatians are presented and the formulation of relativistic gravity theory (RGT) on the basis of a special relativity principle which has been previously used only in respect to mechanical phenomena is completed. Laws of energy-momentum conservation as well as motion momentum conservation are strictly observed and are of covariant nature. A conclusion is made that it is not possible to plot a completely geometrized Lagrangian of a physical field on the basis of Minkowski space and using a tensor physical field. The authors come to a conclusion that there should exist a "latent mass" in the universe for substance full density to equal critical value rhosub(0).

35204 (INIS-SU—321, pp 19-23) **Gravity theory based on Minkowski space and a geometrization principle.** Vlasov, A.A.; Logunov, A.A.; Mestvirishvili, M.A. 1984. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE86780458. (CONF-8407160—Vol.1).

From 7. seminar on problems of high energy physics and quantum field theory; Protvino, USSR (1 Jul 1984).

Field theory of tensor gravitational field is developed on the basis of Minkowski space and geometrization principle. The density of energy-momentum tensor of substance and gravitational field taken together is a source of gravitational field. The harmonicity equation does not limit the choice of the system of coordinates. In contrast to qeneral relativity theory, conservation laws are strictly observed and there are no indications of non-localizability of gravitational field.

35205 **(KFKI—1986-04/A) Half-classical three-body problem.** Revai, J. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). 1986. 17p. (CONF-8506278—1). NTIS (US Sales Only), PC A02/MF A01. File Number DE86901294.

From 10. European symposium on the dynamics of few-body systems; Balatonfured, Hungary (3 Jun 1985).

A three-body system consisting of two heavy particles and a light one is considered. The relative motion of the heavy particles is treated classically, while the light particle motion is described quantum mechanically. The interaction of these two degrees of freedom is self-consitently taken into account by the Feynman path-integral method.

35206 **(KFKI—1986-13/D) Energy transfer problems of ball lightning.** Egely, G. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Apr 1986. 60p. NTIS (US Sales Only), PC A04/MF A01. File Number DE86901420.

The paper analyzes the energy transport phenomenon of ball lightnings, but momentum and charge transport phenomena are considered as well. The physical properties as energy density and transfer are investigated using several observers' accounts of interactions with different objects. It is shown that contrary to previous assumptions the ball lightning has negative electric charge, and very high internal energy density. Both internal and external energy source models are analyzed, and it is shown that regardless to the details of a given model neither of them can explain actual observations. This has been validated by a well documented case study, and by several additional observations. An entirely new, testable model is suggested, which is able to stand for all observed properties of ball lightnings, and it explains the cause of rarity of ball lightnings, and the reasons of the unsuccessful experimental efforts. It is shown that the plasma sphere is just a visible side effect of a more important phenomenon.

35207 **(NBSIR—85-3202) Linear opponent-colors model optimized for brightness prediction.** Howett, G.L. (National Bureau of Standards, Washington, DC (USA)). Feb 1986. Contract AC03-76SF00098. 125p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE86011517.

Formal multivariate optimization techniques were applied in an attempt to determine how well a linear, opponent-colors model of color vision could account for specific brightness-matching data. The data fitted were from a single experiment by Sanders and Wyszecki that matched an adjustable white light in brightness to each of a set of lights of 96 different colors and constant luminance. A generalized, linear, opponent-colors model was formulated, which included the models of Guth (and coworkers), Ingling (and coworkers), and Thornton as special cases. The model contained 10 parameters, including nine determining the spectral responses of the three opponent-level channels, and one determining the rule for combining the outputs of the three channels to obtain an estimate of equivalent luminance (the luminance of an equally bright white light). Despite difficulties with the optimization procedure, a model was found that correlates better than 0.98 with the fitted data. The predictions of this model for various other color-vision functions were explored and compared with corresponding predictions of the Guth and Lodge model and the Thornton model. The new model's predictions of these functions are less than perfect, but surprisingly good considering that the model was optimized entirely on brightness data (the only restriction being that the luminance channel should not have any negative values). The model was shown to predict the sort of complex mixture of sub- and superadditivity that is present in actual data. Some new algebraic results concerning the "B/Y" or "B/L" (equivalent luminance over luminance) ovals on the chromaticity diagram were derived. 14 refs., 37 figs., 4 tabs.

35208 **(ORNL—6217) Enthalpy method for the solidification of a supercooled liquid.** Solomon, A.D.; Alexiades, V.; Wilson, D.G.; Geist, G.; Kerper, J. (Oak Ridge National Lab., TN (USA)). Mar 1986. Contract AC05-84OR21400. 19p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86010073.

The classical enthalpy formulation of phase change processes does not permit modeling solidification of supercooled liquids. This report describes an enthalpy-based method for simulating a freezing process involving a planar front moving into a supercooled but not hypercooled liquid. The method is applicable when the liquid is initially below its equilibrium freezing temperature, T/sub cr/, but above T/sub cr/ - H/c/sub L/. Here H and c/sub L/ are the latent heat of solidification and the specific heat of the liquid respectively. The report also discusses a computer implementation of the method in one-dimension and results of its application to a particular problem with an explicit solution. 10 refs., 3 tabs.

35209 **(UCRL—93820) Evaluated Rayleigh integrals for pulsed planar expanding ring sources.** Warshaw, S.I. (Lawrence Livermore National Lab., CA (USA)). 20 Dec 1985. Contract W-7405-ENG-48. 13p. (CONF-860742—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86006701.

From 12. international congress on acoustics; Toronto, Canada (24 Jul 1986).

Time-domain analytic and semianalytic pressure fields acoustically radiated from expanding pulsed ring sources imbedded in a planar rigid baffle have been calculated. The source functions are radially symmetric delta-function distributions whose amplitude and argument have simple functional dependencies on radius and time. Certain cases yield closed analytic results, while others result in elliptic integrals, which are evaluated to high accuracy by Gauss-Chebyshev and modified Gauss-Legendre quadrature. These results are of value for calibrating computer simulations and convolution procedures, and estimating fields from more complex planar radiators. 3 refs., 4 figs.

35210 **Electro-optic harmonic conversion switch for large-aperture multipass laser systems.** Henesian, M.A.; Goldhar, J.; Haas, R.A. (Lawrence Livermore National Lab., CA). *Optics Letters;* **9**: No. 8, 365-367(Aug 1984). Contract W-7405-ENG-48.

The authors have demonstrated electro-optically tuned second-harmonic generation using Type I KDP inside a plasma-electrode discharge cell. An axial voltage of +/- 52 kV is required to switch a 1.064-μm beam by conversion to 0.53 μm, in agreement with theory. Electro-optically tuned harmonic generation may be combined with a recently developed transparent plasma electrode to produce a large-aperture switch for multipass laser systems. 7 references, 4 figures, 1 table.

35211 **Constant-thickness zone plate as a variational solution.** Tatchyn, R.; Csonka, P.L.; Lindau, I. (Stanford Univ., CA). *Optica Acta;* **31**: No. 7, 729-733(1984).

The diffractive properties of constant-thickness zone plates composed of arbitrary materials are presently well known. Less well known, however, is the fact that the constant-thickness zone plate is the best possible profile that can be created for maximizing the throughput diffraction efficiency of a zone plate system which has a certain symmetry constraint imposed on its geometry. The formal statement of this claim is set forth in this Letter as a variational exercise and the derived optimum constant-thickness solutions are shown to hold for materials of arbitrary complex indices of refraction n. 7 references, 2 figures.

6580 Mathematical Physics

REFER ALSO TO CITATION(S) 35176, 35208, 35383

35212 **(EGG-SAAM—6398-Rev.1) Method of operator splitting or fractional steps and its applications to fluid dynamic modelling. Revision 1.** Berry, R.A. (EG and G Idaho, Inc., Idaho Falls (USA)). Apr 1986. Contract AC07-76ID01570. 32p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86011035.

The basic method of operator splitting or the fractional step method is explained in tutorial fashion. Simple applications are given to illustrate the versatility of the method. The applications are representations of the type of terms which could be encountered in complicated fluid dynamic problems, notably, the equations of chemically reacting flow or multiphase flow. 14 refs.

35213 **ADI as a preconditioning for solving the convection-diffusion equation.** Chin, R.C.Y.; Manteuffel, T.A.; De Pillis, J. (Lawrence Livermore National Lab., CA). *SIAM Journal on Scientific and Statistical Computing;* **5**: No. 2, 281-299(Jun 1984). Contract W-7405-ENG-48;W-7405-ENG-36.

The authors examine a splitting of the operator obtained from a steady convection-diffusion equation with variable coefficients in which the convection term dominates. The operator is split into a dominant and subdominant parts consistent with the inherent directional property of the partial differential equation. The equations involving the dominant parts should be easily solved. The authors accelerate the convergence of this splitting or the outer iteration by a Chebyshev semi-iterative method. When the dominant part has constant coefficients, it can be easily solved using alternating direction implicit (ADI) methods. This is called the inner iteration. The optimal parameters for a stationary two-parameter ADI method are obtained when the eigenvalues become complex. This corresponds to either the horizontal or the vertical half-grid Reynolds number larger than unity. The Chebyshev semi-iterative method is used to accelerate the convergence of the inner ADI iteration. A two-fold increase in speed is obtained when the ADI iteration matrix has real eigenvalues, and the increase is less significant when the eigenvalues are complex. If either the horizontal or the vertical half-grid Reynolds number is equal to one, the spectral radius of the optimal ADI iterative matrix is zero. However, a high degree of nilpotency impairs rapid convergence. This problem is removed by introducing a more implicit iterative method called ADI/Gauss-Seidel (ADI/GS). ADI/GS resolves the nilpotency and, thus, converges more rapidly for half-grid Reynolds number near 1. Finally, these methods are compared with several well-known schemes on test problems. 23 references, 5 figures.

35214 **Non-equilibrium molecular dynamics calculations of the shear viscosity of hard spheres.** Erpenbeck, J.J. (Los Alamos National Lab., NM). *Physica A (Amsterdam);* **118A**: 144-156(1983).

The coefficient of shear viscosity is computed by two non-equilibrium molecular dynamics methods related to those of Lees and Edwards, Evans, and Ashurst and Hoover for hard sphere systems at a fluid density near the solid transition density. One of the methods is isothermal in that it arbitrarily rescales the peculiar velocities. The other permits the system to heat with time. The resulting viscosities are found to agree within the statistical uncertainties for all values of the shear rate studied. Moreover, the non-equilibrium results would appear to be consistent with the zero-shear-rate Green-Kubo results. However, the calculated viscosity shows no evidence for a square-root dependence on shear rate, within the rather large statistical uncertainties, particularly at small shear rate. Moreover, if the authors deduce a square-root dependence from the previously observed long-time tail of the shear viscosity through the Zwanzig relation, then these viscosities appear to disagree significantly. 17 references, 3 figures, 1 table.

70 FUSION ENERGY

7001 Plasma Research

REFER ALSO TO CITATION(S) 35047, 35289, 35294, 35297, 35342

35215 **(CONF-860522—5) Particle flux measurements with pump limiters.** Mioduszewski, P. (Oak Ridge National Lab., TN (USA)). 1986. Contract AC05-84OR21400. 18p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86011069.

From 7. international conference on plasma surface interactions in controlled fusion devices; Princeton, NJ, USA (5 May 1986).

The pressure buildup in pump limiters is a function of the incident particle flux, the pump limiter geometry, particle-surface interactions, and, under certain conditions, nonlinear effects due to interactions of the neutral gas with the incoming plasma. At sufficiently low density and for short pump limiter throat, the pressure observed in the pump limiter chamber is a direct measure of the particle flux at the limiter slot. This paper discusses a simple model for the correlation between particle flux and pump limiter pressure. In addition, some estimates are presented on the thermalization of fast neutrals in the pump limiter duct and its implications for "enhanced particle collection."

35216 **(CONF-860522—10) Scrapeoff layer studies with an instrumented limiter.** Mioduszewski, P.; Edmonds, P.H.; Emerson, L.C.; Simpkins, J.E. (Oak Ridge National Lab., TN (USA)). 1986. Contract AC05-84OR21400. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011505.

From 7. international conference on plasma surface interactions in controlled fusion devices; Princeton, NJ, USA (5 May 1986).

An instrumented limiter was used as a diagnostic to measure energy deposition and power fluxes in the scrapeoff layer. The limiter consisted of an array of 12 tiles, each equipped with a thermocouple. This arrangement represented a calorimeter array that yielded the total limiter energy and decay length of the power flux in the scrapeoff layer. Energy deposition and decay lengths are discussed for various plasma parameters.

35217 **(DOE/ER/13447—1) Accurate alpha sticking fractions from improved three-body calculations relevant for muon catalyzed fusion. Progress report, September 1, 1985-August 31, 1986.** Szalewicz, K.; Monkhorst, H.J. (Florida Univ., Gainesville (USA). Dept. of Physics). Apr 1986. Contract FG05-85ER13447. 14p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86010919.

A solution of the Coulomb three-body problem is the beginning point for calculations of sticking fractions in muon catalyzed fusion. The basis set is constructed from the following functions ξ/sup r/n/sup s/e/sup - $\alpha\xi$ - β n/R/sup $^{-3}$/2//H/sub eta/(x)exp(-x^2/2), where ξ and eta are elliptic coordinates of muon, R is the internuclear distance, H/sub eta/ is the nth Hermite polynomial, and x = γ (R-R/sub e/). The nonlinear parameters α, β, γ, and R/sub e/ are to be optimized. 21 refs., 1 tab.

35218 **(DOE/ER/53202—T2) Theoretical studies of controlled fusion. Final report.** Krall, N.A. (JAYCOR, San Diego, CA (USA)). 31 Mar 1986. Contract FG03-85ER53202. 82p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86010933.

Transport in FRC was studied analytically and numerically. The physics considered included lower-hybrid-drift turbulence, rapid convection along closed magnetic field lines, nonadiabaticity, and large particle orbits. The study also extended conventional modeling procedures by developing nonlocal models of stability and transport and determined the relation between such models and the more widely used local models.

35219 **(DOE/ET/53088—236) Electron diffusion in tokamaks due to electromagnetic fluctuations.** Horton, W.; Choi, D.I.; Yushmanov, P.N.; Parail, V.V. (Texas Univ., Austin (USA). Inst. for Fusion Studies; Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). May 1986. Contract FG05-80ET53088. 29p. (IFSR—236). NTIS, PC A03/MF A01; GPO Dep. File Number DE86011331.

Calculations for the stochastic diffusion of electrons in tokamaks due to a spectrum of electromagnetic drift fluctuations are presented. The parametric dependence of the diffusion coefficient on the amplitude and phase velocity of the spectrum, and the bounce frequency for the electrons is studied. The wavenumber spectrum is taken to be a low order (5 x 5) randomly-phased, isotropic, Monotonic spectrum extending from k /sub perpendicular min/ $\simeq$ ω/sub ci//c/sub s/ to k/sub perpendicular max/ $\simeq$ 3ω/sub pe//c with different power laws of decrease phi k $\simeq$ phi 1/k/sup m/, 1 $\leqq$ m $\leqq$ 3. A nonlinear Ohm's law is derived for the self-consistent relation between the electrostatic and parallel vector potentials. The parallel structure of the fluctuations is taken to be such that k parallel/sup nl/ν/sub e/ $<$ w/sub k/ due to the nonlinear perpendicular motion of the electrons described in the nonlinear Ohm's law. The diffusion coefficient scales approximately as the neo-Alcator and Merezhkin-Mukhovatoc empirical formulas for plasma densities above a critical density.

35220 **(EUR-CEA-FC—1252) Non-linear diffusion of charged particles in a turbulent magnetoplasma.** Misguich, J.H.; Balescu, R.; Pecseli, H.L.; Mikkelsen, T.; Larsen, S.E.; Qiu Xiaoming. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Recherches sur la Fusion Controlee). May 1985. 196p. NTIS (US Sales Only), PC A09/MF A01. File Number DE86751880.

A unified theory is presented which describes non-linear effects on relative and absolute diffusion of charged particles in a magnetoplasma, in analogy with analogous methods used for diffusion studies of pollutants in the environment. Explicit results are obtained for non-linear diffusion of test particles represented by their guiding centers in a turbulent energy spectrum in K-1 and K-3, which corresponds to recent measurements in the T.F.R. Tokamak. As expected, a BOHM scaling of the absolute diffusion coefficient is obtained for frozen turbulence. The growth of an initially small cloud of particles in an arbitrary turbulent medium corresponds to the process of relative diffusion. It is described by a generalization of the Brownian motion, including a first stage of very slow initial relative diffusion, followed by a stage of rapid expansion of the cloud up to the final stage in which particles become uncorrelated, and Brownian diffusion is reached asymptotically. The stage of exponential growth, observed in fluid turbulence corresponds to the clump effect in plasma turbulence. It is entirely due to the effect of trajectory correlations. The LJAPUNOV exponent of this exponential separation is obtained analytically. Numerical solutions of the diffusion equation are presented for the effective radius of the cloud as function of time in the case of a model spectrum of drift-wave turbulence. When compared with classical Brownian diffusion of uncorrelated particles, the effective "diffusion coefficient" for correlated particles is found to be reduced by orders of magnitude for rather long times. Practical implications for experimental situations are also discussed (Barium clouds released in the ionosphere, pellet injection in e.g. Tokamaks).

35221 **(EUR-CEA-FC—1266) Charged fusion product analysis as diagnostics in high energy deuterium beams.** Bayetti, P.; Bottiglioni, F.; Martin, G.; Pamela, J. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Recherches sur la Fusion Controlee). May 1985. 23p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86751876.

The detection of protons (3 MeV) and tritons (1 MeV) originating from D-D fusion reactions are presented as a tool for inferring the main features of a powerful deuterium neutral beam. By an energy analysis, beam species content, neutralisation and power transmission efficiencies have been measured. Using a localisation detector, a method for measuring beam profiles has been developed.

35222 **(EUR-CEA-FC—1267) Non thermal cyclotron emission and absorption.** Rax, J.M. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Recherches sur la Fusion Controlee). May 1985. 21p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86751878.

The non-thermal electron cyclotron emission and absorption during radio-frequency heating in a fusion plasma are expressed in term of the incident power.

35223 **(EUR-CEA-FC—1269) Regularity conditions of the field on a toroidal magnetic surface.** Bouligand, M. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Recherches sur la Fusion Controlee). Jun 1985. 12p. (In French). NTIS (US Sales Only), PC A02/MF A01. File Number DE86751882.

We show that a field B vector which is derived from an analytic canonical potential on an ordinary toroidal surface is regular on this surface when the potential satisfies an elliptic equation (owing to the conservative field) subject to certain conditions of regularity of its coefficients.

35224 **(EUR-CEA-FC—1272) Eigenvalues of the simplified ideal MHD ballooning equation. Pt.2. The eigenvalue problem.** Paris, R.B.; Auby, N.; Dagazian, R.Y. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Recherches sur la Fusion Controlee). Jun 1985. 52p. NTIS (US Sales Only), PC A04/MF A01. File Number DE86751883.

The investigation of the spectrum of the simplified differential equation describing the variation of the amplitude of the ideal MHD ballooning instability along magnetic field lines constitutes a multiparameter Schroedinger eigenvalue problem. An exact eigenvalue relation for the discrete part of the spectrum is obtained in

terms of the oblate spheroidal functions. The dependence of the eigenvalues lambda on the two free parameters γ^2 and μ^2 of the equation is discussed, together with certain analytical approximations in the limits of small and large γ^2. A brief review of the principal properties of the spheroidal functions is given in an appendix.

35225 **(EUR-CEA-FC—1274) Laser-injected impurity transport in ohmic and ICRF-heated TFR plasmas.** (Association Euratom-CEA, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Recherches sur la Fusion Controlee). Jun 1985. 27p. NTIS (US Sales Only), PC A03/MF A01. File Number DE86751877.

The transport of impurities into ohmic and ion-cyclotron radio-frequency (ICRF) heated plasmas has been studied by laser blow-off injection of vanadium. No difference has been found between the two experimental situations, in spite of the fact that degradation of the energy confinement time is observed in ICRF heated plasmas in the mode conversion regime. Additionally, simulation of the saw-tooth modulated He-like V^{21+} resonance line has shown that the impurity transport parameters are not modified by the internal disruptions.

35226 **(GA-A—18375) Multichordal charge exchange recombination spectroscopy on the DIII-D tokamak.** Seraydarian, R.P.; Burrell, K.H. (GA Technologies, Inc., San Diego, CA (USA)). Mar 1986. Contract AC03-84ER51044. 14p. (CONF-860324—28). NTIS, PC A02/MF A01; GPO Dep. File Number DE86010685.

From High temperature plasma diagnostics; Hilton Head Island, SC, USA (9 Mar 1986).

Ion temperature and rotation speed profiles will be measured spectroscopically on DIII-D using charge-exchange-induced excitation of spectral lines. Compared to the spectroscopic system used on Doublet III, the DIII-D system will have improved spatial and temporal resolution, reduced instrumental contribution to line broadening, and the capability to measure both toroidal and poloidal rotation.

35227 **(GA-A—18428) Beta and current limits in the Doublet III tokamak.** Strait, E.J.; Chu, M.S.; Jahns, G.L.; Kim, J.S.; Kellman, A.G.; Lao, L.L.; Lee, J.K.; Moore, R.W.; St. John, H.; Overskei, D.O.; Snider, R.T.; Stambaugh, R.D.; Taylor, T.S. (GA Technologies, Inc., San Diego, CA (USA)). Apr 1986. Contract AC03-84ER51044. 7p. (CONF-860412—9). NTIS, PC A02/MF A01; GPO Dep. File Number DE86010751.

From 13. European conference on controlled fusion and plasma heating; Schliersee, F.R. Germany (14 Apr 1986).

Neutral-beam heated discharges in Doublet III exhibit an operational beta limit, β/sub T/(%) $\leq$ 3.5 I(MA)/a(m)B(T), in good agreement with several theoretical predictions for ideal external kink or ballooning modes. These theories predict that the β limit has no explicit dependence on plasma shape (for nominal dee shapes). This aspect of the theory was confirmed in Doublet III by varying the elongation (κ) from 1.0 to 1.6 and the triangularity (δ) from -0.1 to 0.9 and finding in all cases the same β limit. The maximum achievable beta thus depends on the minimum achievable value of the safety factor q. In Doublet III, the operational current limit is given by $q \geq 1.7$ for limiter-defined discharges and $q \geq 2.7$ for separatrix-defined discharges. Operation with $q \sim 2$ was achieved for $1.0 \leq \kappa \leq 1.6$. Both β and q limits are characterized by major disruptions which usually terminate the discharge. In both cases, the disruptions often have a precursor oscillation with toroidal mode number $n = 1$, poloidal mode number $m = 2$ or 3, a frequency of zero to a few kHz, and a growth time on the order of a millisecond. These observations suggest that the proximate cause of these disruptions is a kink or tearing mode, pressure-driven in one case and current-driven in the other. Theoretical analyses of discharges at both limits will be compared. Modes with a high toroidal mode number, $3 \leq n \leq 5$, and ballooning character have been observed near the β/sub T/ limit. These modes do not appear to be closely connected with the disruptions. Heating efficiency, $\Delta W/\Delta P$, remains constant up to the limiting disruption. Fishbone modes appear to be mainly a feature of high β/sub p/ operation and not connected to the β/sub T/ limit.

35228 **(GTFR—62) Impurity asymmetries and radial transport produced by asymmetric impurity sources.** Stacey, W.M. Jr. (Georgia Inst. of Tech., Atlanta (USA). Fusion Research Center). May 1986. Contract AS05-78ET52025. 20p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86011155.

A fluid theory is presented for the effects of poloidal asymmetries in impurity sources upon the poloidal asymmetry over the flux surface of the impurity density and upon radial impurity transport in tokamak plasmas. Poloidal locations of limiters or divertors which would minimize inward impurity transport are identified.

35229 **(IAE—3828/6) Radial structure of a dissipative instability of ballooning modes.** Pogutse, O.P.; Chudin, N.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1983. 16p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE86702120.

A variational method for deriving an equation to describe the radial structure of both ideal and dissipative ballooning modes is formulated. Ballooning modes are plasma oscillations in toroidal systems which are described by differential equations in partial derivatives of the second order. As compared with the known Connor-Haslil-Taylor method based on the expansion of a complete differential equation in partial derivatives by small parameter (relation of the lenght of perturbation envelope localization over the radius to characteristic inhomogeneity size), the suggested method is much simpler and admits generalization. It permits, particularly, to investigate the radial structure of thresholdless dissipative instability of ballooning modes.

35230 **(IAE—3928/6) Physical nature and theory of the tearing mode.** Kutvitskij, V.A.; Yurchenko, Eh.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1984. 36p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE86702121.

The theory of tearing instability in tokamaks is under discussion. Analytical consideration of the tearing mode is conducted for two simple models: flat pinch and "cylindrical tokamak". Linear and nonlinear stages of the process are considered along with the tearing-mode coupling with helical instability. Some disadvantages of the nonlinear theory are noted.

35231 **(IAE—4033/8) Physical understanding of a criterion of the major disruption.** Il'inskij, V.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1984. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE86702117.

Criteria of the major disruption in tokamak plasma are obtained using the bifurcation theory. Equations of the balance of ion and electron energy are considered as initial ones. The criteria obtained are investigated for the case of adiabatic plasma compression. Distribution functions of a noise of the parameter suffering from a catastrophe are found out using the Fokker-Plank equation.

35232 **(INIS-mf—10137) Spatially resolved determination of plasma parameters of a noble gas linear MHD generator.** Wetzer, J.M. (Technische Hogeschool Eindhoven (Netherlands)). 7 Sep 1984. 122p. NTIS (US Sales Only), PC A06/MF A01. File Number DE86702119.

The discharge structure of noble gas linear MHD generators is strongly nonuniform. Description of the transport properties and of the mechanisms of momentum and energy transfer requires detailed knowledge of the parameters of the discharge structure. It is the aim of this work to provide detailed experimental information on these parameters. A set of diagnostic techniques has been developed for the spatially resolved determination of streamer parameters of a noble gas linear MHD generator. The working medium is an atmospheric cesium-seeded argon plasma. The diagnostics involve spectroscopic techniques, and a quantitative schlieren technique called the laser beam deflection method. These methods are described. Special attention is paid to the requirements with respect to spatial and temporal resolution. An advanced reconstruction

technique has been developed to derive the spatial distribution of plasma parameters from stereoscopic radiation measurements.

35233 (IPP—5/7) **Assessment of pellet injection for NET. Pt. 4. An estimate of the effect of energy carriers other than thermal electrons on the ablation of pellets in plasmas. An extension of the electron temperature range previously considered.** Lengyel, L.L. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Dec 1985. 22p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86752033.

The effect of runaway electrons, NB ions and alpha particles is estimated by calculating the reduced ablation rates due to these particles in fusion plasmas and using the ablation rate induced by thermal electrons as reference quantity. Calculations were made for various energy content (i.e. beta) ratios and for a fusion-relevant electron temperature range (Tsub(e) up to 25 keV). (orig.).

35234 (IPP—III/102) **Probe and thermographic measurements in the ASDEX divertor.** Ditte, U.; Grave, T. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Dec 1985. 63p. NTIS (US Sales Only), PC A04/MF A01. File Number DE86752038.

Measurements of plasma parameters in the divertor scrape-off, like temperature and density profiles and power flow onto the divertor plates, are presented for different main plasma conditions (OH-phase, L-phase, H-phase with bursts, H-phase without bursts, LH-current drive). Statements about fast electrons, deviations from a Maxwellian electron distribution function and the electric potential in the scrape-off plasma are made. Comparison between probe measurements, microwave interferometry, Thomson scattering and measurements of the power flow onto the divertor plates are discussed. (orig.).

35235 (IPP—III/107) **ASDEX papers at the 12th European conference on controlled fusion and plasma physics.** (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Nov 1985. 93p. (CONF-850927—Exc.). NTIS (US Sales Only), PC A05/MF A01. File Number DE86752047.

From 12. European conference on controlled fusion and plasma physics; Budapest, Hungary (2 Sep 1985).

This report is a collection of 20 IPP Garching contributions to the conference. It gives an impression of the latest research results particularly with respect to plasma confinement and production of plasma impurities in ASDEX while being heated by neutral beams and RF. The contributions have been taken up separately into the data base. (GG).

35236 (IPP—III/107, pp 29-32) **Anomalous transport and unstable modes in neutral-beam-heated L and H plasmas of ASDEX.** Becker, G. (Association Euratom-Max-Planck-Institut fuer Plasmaphysik, Garching, Germany, F.R.). Nov 1985. NTIS (US Sales Only), PC A05/MF A01. File Number DE86752047. (CONF-850927—Exc.).

From 12. European conference on controlled fusion and plasma physics; Budapest, Hungary (2 Sep 1985).

It is attempted to determine the type of instabilities which are probably responsible for anomalous transport in the L and H regimes. Resistive and ideal ballooning modes are found to be stable. With collisionality factors νsub(*e,i)<1, dissipative trapped-electron and trapped-ion modes are unstable in the L and H discharges and should be the prevailing drift instabilities. The time evolution of etasub(e,i) = d ln Tsub(e,i)/d ln n, which are important parameters for these modes, is shown to be correlated with L and H transport. The operational limits of the H regime are found to be connected with variations of etasub(e,i), which primarily result from changing the profiles of injection heating and beam fuelling. (orig.).

35237 (IPP—III/107, pp 33-36) **Transient behaviour of the beta limit in ASDEX.** Gierke, G. v.; Keilhacker, M.; Becker, G.; Bosch, H.S.; Eberhagen, A.; Fussmann, G.; Gehre, O.; Gernhardt, J.; Glock, E.; Gruber, O. (Association Euratom-Max-Planck-Institut fuer Plasmaphysik, Garching, Germany, F.R.; Comitato Nazionale per l'Energia Nucleare, Frascati, Italy; Nuclear Development Corp. of South Africa, Pty. Ltd., Pelindaba, Pretoria; CEA Centre d'Etudes Nucleaires de Grenoble, 38, France). Nov 1985. NTIS (US Sales Only), PC A05/MF A01. File Number DE86752047. (CONF-850927—Exc.).

From 12. European conference on controlled fusion and plasma physics; Budapest, Hungary (2 Sep 1985).

In a previous paper it was shown that the β limit in ASDEX follows a law βsub(max) = C . I/(a . B) (%,MA,m,T) which C approx.= 3.5 for βsup(equ) (β from equilibrium measurements) and c approx.= 2.8 for βsup(dia) (β from a diamagnetic loop), in agreement with theoretical predictions. It was also pointed out that β - at constant neutral beam power - cannot be kept at the maximum value but decreases to a lower value. It was speculated that this decay in β corresponds to a resistive adjustment of the current density distribution to the less favourable broad H-mode temperature profiles. This contribution discusses the transient behaviour of the β limit and shows that in ASDEX H-discharges the stationary β limit (for βsup(dia)) lies about 20-30% below the maximum value. (orig./GG).

35238 (IPP—III/107, pp 37-40) **Investigations into the density limit of the tokamak with ohmic and neutral beam heating.** Niedermeyer, H.; Becker, G.; Bosch, H.S.; Brocken, H.; Eberhagen, A.; Fussmann, G.; Gehre, O.; Gernhardt, J.; Gierke, G. v.; Glock, E. (Association Euratom-Max-Planck-Institut fuer Plasmaphysik, Garching, Germany, F.R.; Comitato Nazionale per l'Energia Nucleare, Frascati, Italy; Nuclear Development Corp. of South Africa, Pty. Ltd., Pelindaba, Pretoria; GA Technologies, Inc., San Diego, CA, USA; CEA Centre d'Etudes Nucleaires de Grenoble, 38, France). Nov 1985. NTIS (US Sales Only), PC A05/MF A01. File Number DE86752047. (CONF-850927—Exc.).

From 12. European conference on controlled fusion and plasma physics; Budapest, Hungary (2 Sep 1985).

It was shown previously that in ASDEX the disruption at the density limit in an ohmic discharge at q=4.2 is preceded by the poloidally asymmetric formation of a cold high density plasma near the boundary ('marfe') and a shrinking of the current profile. In order to get an improved data base for an empirical density limit scaling and more insight into the phenomena involved we now extended our investigations to discharges in a large parameter range including neutral beam heating. (orig./GG).

35239 (IPP—III/107, pp 41-44) **Neutron production during deuterium injection in deuterium plasmas in ASDEX.** Huebner, K.; Baetzner, R.; Hinsch, H.; Rapp, H.; Wurz, H.; Eberhagen, A.; Gehre, O.; Mertens, V. (Heidelberg Univ., Germany, F.R. Inst. fuer Angewandte Physik; Association Euratom-Max-Planck-Institut fuer Plasmaphysik, Garching, Germany, F.R.). Nov 1985. NTIS (US Sales Only), PC A05/MF A01. File Number DE86752047. (CONF-850927—Exc.).

From 12. European conference on controlled fusion and plasma physics; Budapest, Hungary (2 Sep 1985).

Measurements of neutron energy spectra and time dependent neutron rate are presented. They agree well with the results of a simple classical deuteron relaxation model. Determination of the plasma deuterium temperature seems possible from the energy spectra as well as from the neutron rate. (orig./GG).

35240 (IPP—III/107, pp 73-76) **Lower hybrid current drive in the ASDEX tokamak.** Leuterer, F.; Eckhartt, D.; Soeldner, F.; Becker, G.; Bernhardi, K.; Bosch, H.S.; Brambilla, M.; Brocken, H.; Derfler, H.; Eberhagen, A. (Association Euratom-Max-Planck-Institut fuer Plasmaphysik, Garching, Germany, F.R.; Comitato Nazionale per l'Energia Nucleare, Frascati, Italy; CEA Centre d'Etudes Nucleaires de Grenoble, 38, France; Nuclear Development Corp. of South Africa, Pty. Ltd., Pelindaba, Pretoria; Washington Univ., Seattle, USA). Nov 1985. NTIS (US Sales Only), PC A05/MF A01. File Number DE86752047. (CONF-850927—Exc.).

From 12. European conference on controlled fusion and plasma physics; Budapest, Hungary (2 Sep 1985).

Lower hybrid heating and current drive experiments at 1.3 GHz with up to 800 kW/1.5 sec pulses have been performed in ASDEX in a wide parameter range, anti nsub(e) = 0.2 - 5 x 10^{13} cm^{-3}, Bsub(t) = 2 - 2.5 T, and Isub(p) = 140 - 400 kA. For the current drive experiments reported here, the eight waveguide grill is operated with a relative phase of $\pi/2$ between successive waveguides. These experiments have been performed in two different modes of operation. (orig./GG).

35241 (IPP—III/107, pp 77-80) **Power absorption studies for lower hybrid heating and current drive in ASDEX.** Soeldner, F.; Eckhartt, D.; Leuterer, F.; Eberhagen, A.; Giuliana, A.; Mueller, E.R.; Murmann, H.; Becker, G.; Bosch, H.S.; Brambilla, M. (Association Euratom-Max-Planck-Institut fuer Plasmaphysik, Garching, Germany, F.R.; Comitato Nazionale per l'Energia Nucleare, Frascati, Italy; CEA Centre d'Etudes Nucleaires de Grenoble, 38, France; Nuclear Development Corp. of South Africa, Pty. Ltd., Pelindaba, Pretoria; Washington Univ., Seattle, USA). Nov 1985. NTIS (US Sales Only), PC A05/MF A01. File Number DE86752047. (CONF-850927—Exc.).

From 12. European conference on controlled fusion and plasma physics; Budapest, Hungary (2 Sep 1985).

In LH heating and current drive experiments similar results are obtained for the absorption of RF power. At low density (anti nsub(e) < or approx. 2 x 10^{13} cm^{-3}) a suprathermal electron distribution is formed and a large fraction of the RF power is coupled to fast electrons. The RF absorption coefficient in this regime is of order 0.5. The energy confinement is improved above the ohmic values. At higher densities where fast ions are produced the RF absorption is poor (α approx.= 0.2) and the confinement is degraded. The electron regime therefore is preferable for LH heating. The best results may be obtained if current drive and heating are present simultaneously. (orig./GG).

35242 (IPP—III/107, pp 81-84) **Measurement of the current distribution in ASDEX during lower hybrid current drive using the Li-beam/Zeeman effect technique.** McCormick, K.; Bosch, H.S.; Brambilla, M.; Derfler, H.; Eberhagen, A.; Eckhartt, D.; Fussmann, G.; Gehre, O.; Gernhardt, J.; Gierke, G. v. (Association Euratom-Max-Planck-Institut fuer Plasmaphysik, Garching, Germany, F.R.; Comitato Nazionale per l'Energia Nucleare, Frascati, Italy; CEA Centre d'Etudes Nucleaires de Grenoble, 38, France; Nuclear Development Corp. of South Africa, Pty. Ltd., Pelindaba, Pretoria). Nov 1985. NTIS (US Sales Only), PC A05/MF A01. File Number DE86752047. (CONF-850927—Exc.).

From 12. European conference on controlled fusion and plasma physics; Budapest, Hungary (2 Sep 1985).

Results are presented for an exploratory investigation into the behavior of the current density distribution during LH current drive. Indications are that the current profile broadens slightly, in contrast to a peaking of the electron temperature profile, thereby implying that the RF-driven current is not strictly coupled to Spitzer conductivity. (orig.).

35243 (IPP—III/107, pp 85-88) **Low energy neutral particle analysis at the ASDEX tokamak.** Verbeek, H. (Association Euratom-Max-Planck-Institut fuer Plasmaphysik, Garching, Germany, F.R.). Nov 1985. NTIS (US Sales Only), PC A05/MF A01. File Number DE86752047. (CONF-850927—Exc.).

From 12. European conference on controlled fusion and plasma physics; Budapest, Hungary (2 Sep 1985).

The neutral particle flux emitted by a Tokamak due to charge exchange of plasma ions with the neutral gas contains a large amount of neutrals with energies below 200 eV. These low energy neutrals originate predominantly from the plasma edge where the neutral gas density is high. They are not detected by the common neutral particle analyzers which are based on stripping in a gas cell followed by electromagnetic analyzers. However, this low energy neutral flux contributes significantly to the plasma wall interaction, i.e. impurity release and recycling at the walls. (orig./GG).

35244 (IPP—III/107, pp 89-92) **Flux measurements with a sniffer probe near the wall in ASDEX.** Poschenrieder, W.; Venus, G.; Wang, Y.G.; Mueller, E.R.; Bartiromo, R.; Becker, G.; Bosch, H.S.; Brocken, H.; Eberhagen, A.; Fussmann, G. (Association Euratom-Max-Planck-Institut fuer Plasmaphysik, Garching, Germany, F.R.). Nov 1985. NTIS (US Sales Only), PC A05/MF A01. File Number DE86752047. (CONF-850927—Exc.).

From 12. European conference on controlled fusion and plasma physics; Budapest, Hungary (2 Sep 1985).

For a detailed assessment of particle recycling in a tokamak it is necessary to know quality and quantity of the particle fluxes directed to the elements of the wall. In a divertor machine like ASDEX we have to differentiate between at least four distinct elements: main chamber wall, protective limiters, collector plates, and divertor walls. Relevant data about the divertor region are obtained from pressure and flux measurements. (orig./GG).

35245 (ITEF—4(1985)) **Equilibrium states of a radiative Z-pinch with account of thermal conductivity.** Bobrova, N.A.; Razinkova, T.L. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1985. 62p. (In Russian). NTIS (US Sales Only), PC A04/MF A01. File Number DE86702118.

The equilibrium state of a cylindrically symmetric radiative Z-pinch is considered, taking into account the thermal conductivity. The radiation losses of energy are due to a heavy impurity in deitereum (xenon). The solution dependence on two dimensionless parameters delta and P, characterizing thermal conductivity and plasma boundary pressure, was investigated. Analytical solutions are obtained for two cases: delta << 1 and delta >> 1. Solution for intermediate region was obtained numerically. Radial distributions of steady-state plasma density, temperature and magnetic field strength are found for given radiation losses and different values of parameters delta and P. The obtained distributions describe radial structure of a plasma focus equilibrium state at the end of the first compression.

35246 (LA-UR—86-1279) **Future of plasma simulation.** Forslund, D.W. (Los Alamos National Lab., NM (USA)). 1986. Contract W-7405-ENG-36. 4p. (CONF-8604176—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86010182.

From Workshop on scientific applications and algorithm design for high speed computing; Champaign, IL, USA (7 Apr 1986).

The author briefly comments on factors essential to improving the capabilities of plasma modeling. These factors include high input/output performance, large solid state disk capacity, symbolic debugging tools, high speed graphics, high speed image generation and workstations for pre- and post-processing. Also important is the development of additional software to provide an enhanced interface between the work-stations and supercomputers. (DWL)

35247 **(LA-UR—86-1809) Plasma-surface interactions in the ZT-40M reversed-field pinch.** Cayton, T.E.; Downing, J.N.; Weber, P.G.; Baker, D.A.; Bastasz, R.J.; Buchenquer, C.J.; Burkhardt, L.C.; DiMarco, J.N.; Erickson, R.M.; Forman, P.R. (Los Alamos National Lab., NM (USA); Sandia National Labs., Livermore, CA (USA)). 1986. Contract AC04-76DR00789;W-7405-ENG-36. 48p. (CONF-860522—3). NTIS, PC A03/MF A01; GPO Dep. File Number DE86011226.

From 7. international conference on plasma surface interactions in controlled fusion devices; Princeton, NJ, USA (5 May 1986).

Plasma-surface interactions strongly influence the properties of plasma produced in the ZT-40M reversed-field pinch, which generally operates without discrete limiters. Z/sub eff/ data and spectroscopy, together with total radiated power, and measured impurity accumulations on collector probes demonstrate that metal impurities play a determining role in ZT-40M's performance. Plasma currents of 60 to 400 kA routinely generate total betas of 5 to 10% (assuming T/sub i/ = T/sub e/). ZT-40M's inherently large ohmic heating power yields T/sub e/ $\geq$ 500 eV for 400 kA flat-top discharges with anti n/sub e/ $\sim 4 \times 10^{19}$ m^{-3}. Pulse duration at the lower currents has reached ~35 ms. Energy confinement time Tau/sub E/ has reached 0.7 ms for discharges with anti n/sub e/ = 8×10^{19} m^{-3} and T/sub e/ = 330 eV at a current of 330 kA. Magnetic field errors intrinsic to the winding and core configuration create localized, intense plasma-surface interactions that define the present operating boundary for ZT-40M. Discharge cleaning, either pulsed or glow, of the Inconel vacuum vessel increases the deuterium recycling rate and decreases the impurity fractions, leading to discharges with higher density and lower temperature, loser Z/sub eff/, lower resistive anomaly factor, and better overall confinement of particles and energy. Carbon films ~40 monolayers thick are used in ZT-40M to simulate the recycling, fueling, and sputtering conditions that may be encountered in next generation devices with large areas of carbon.

35248 **(PPPL—2153R) Ohm's law for mean magnetic fields.** Boozer, A.H. (Princeton Univ., NJ (USA). Plasma Physics Lab.). May 1986. Contract AC02-76CH03073. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011169.

The magnetic fields associated with plasmas frequently exhibit small amplitude MHD fluctuations. It is useful to have equations for the magnetic field averaged over these fluctuations, the so-called mean field equations. Under very general assumptions it is shown that the effect of MHD fluctuations on a force-free plasma can be represented by one parameter in Ohm's law, which is effectively the coefficient of electric current viscosity.

35249 **(PPPL—2262) Linear stability of tearing modes.** Cowley, S.C.; Kulsrud, R.M.; Hahm, T.S. (Princeton Univ., NJ (USA). Plasma Physics Lab.). May 1986. Contract AC02-76CH03073. 62p. NTIS, PC A04/MF A01; GPO Dep. File Number DE86011358.

This paper examines the stability of tearing modes in a sheared slab when the width of the tearing layer is much smaller than the ion Larmor radius. The ion response is nonlocal, and the quasineutrality retains its full integal form. An expansion procedure is introduced to solve the quasineutrality equation in powers of the width of the tearing layer over the ion Larmor radius. The expansion procedure is applied to the collisionless and semi-collisional tearing modes. The first order terms in the expansion we find to be strongly stabilizing. The physics of the mode and of the stabilization is discussed. Tearing modes are observed in experiments even though the slab theory predicts stability. It is proposed that these modes grow from an equilibrium with islands at the rational surfaces. If the equilibrium islands are wider than the ion Larmor radius, the mode is unstable when Δ' is positive.

35250 **(PPPL—2319) Neutral particle kinetics in fusion devices.** Tendler, M.; Heifetz, D. (Princeton Univ., NJ (USA). Plasma Physics Lab.). May 1986. Contract AC02-76CH03073. 57p. NTIS, PC A04/MF A01; GPO Dep. File Number DE86011165.

The theory of neutral particle kinetics treats the transport of mass, momentum, and energy in a plasma due to neutral particles which themselves are unaffected by magnetic fields. This transport affects the global power and particle balances in fusion devices, as well as profile control and plasma confinement quality, particle and energy fluxes onto device components, performance of pumping systems, and the design of diagnostics and the interpretation of their measurements. This paper reviews the development of analytic, numerical, and Monte Carlo methods of solving the time-independent Boltzmann equation describing neutral kinetics. These models for neutral particle behavior typically use adaptations of techniques developed originally for computing neutron transport, due to the analogy between the two phenomena, where charge-exchange corresponds to scattering and ionization to absorption. Progress in the field depends on developing multidimensional analytic methods, and obtaining experimental data for the physical processes of wall reflection, the neutral/plasma interaction, and for processes in fusion devices which are directly related to neutral transport, such as H/sub α/ emission rates, plenum pressures, and charge-exchange emission spectra.

35251 **(PPPL—2323) Introducing PAP: a plasma apprentice program.** Mynick, H.E. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Apr 1986. Contract AC02-76CH03073. 39p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86011170.

Although current capabilities of symbolic computation and artificial intelligence are not adequate to do all the types of thinking a physicist does in solving physics problems, much of what the human theorist does can be effectively imitated by a computer. This paper describes an early stage of implementation of an apprentice program for aiding plasma theorists in developing plasma physics theory, by performing some of those tasks which the theorist normally must do, but which are now amenable to machine imitation. The apprentice has a "knowledge base" containing its understanding of plasma theory, which can be accessed by the human user for pedagogic purposes, as well as by the apprentice itself, and some ability to do the kinds of qualitative or heuristic reasoning necessary to the human theorist in solving problems. These facilities enable the apprentice itself to do plasma calculations, informing the user of the progress of the calculation, and prompting him when a decision is needed which the apprentice is not equipped to handle. Some extensions planned for the future are discussed.

35252 **(PPPL—2325) NOVA: a nonvariational code for solving MHD stability of axisymmetric toroidal plasmas.** Cheng, C.Z.; Chance, M.S. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Apr 1986. Contract AC02-76CH03073. 48p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86011164.

A nonvariational approach for determining the ideal MHD stability of axisymmetric toroidal confinement systems is presented. The code (NOVA) employs cubic B-spline finite elements and Fourier expansion in a general flux coordinate (psi, θ, zeta) system. Better accuracy and faster convergence were obtained in comparison with the variational PEST and ERATO codes. The nonvariational approach can be extended to problems having non-Hermitian eigenmode equations where variational energy principles cannot be obtained.

35253 **(PPPL—2327) High beta plasmas in the PBX tokamak.** Bol, K.; Buchenauer, D.; Chance, M.; Couture, P.; Fishman, H.; Fonck, R.; Gammel, G.; Grek, B.; Ida, K.; Itami, K. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Apr 1986. Contract AC02-76CH03073. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011173.

Bean-shaped configurations favorable for high β discharges have been investigated in the Princeton Beta Experiment (PBX) tokamak. Strongly indented bean-shaped plasmas have been successfully formed, and beta values of over 5% have been obtained with 5 MW of injected neutral beam power. These high beta discharges still lie in the first stability regime for ballooning modes, and MHD stability analysis implicates the external kink as responsible for the present β limit.

35254 (PPPL—2328) Experimental investigation on electron cyclotron absorption at down-shifted frequency in the PLT tokamak. Mazzucato, E.; Fidone, I.; Cavallo, A.; von Goeler, S.; Hsuan, H. (Princeton Univ., NJ (USA). Plasma Physics Lab.). May 1986. Contract AC02-76CH03073. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011161.

The absorption of 60 GHz electron cyclotron waves, with the extraordinary mode and an oblique angle of propagation, has been investigated in the PLT tokamak in the regime of down-shifted frequencies. The production of energetic electrons, with energies of up to 300 to 400 keV, peaks at values of toroidal field ($\approx$29 kG) for which the wave frequency is significantly smaller than the electron cyclotron frequency in the whole plasma region. The observations are consistent with the predictions of the relativistic theory of electron cyclotron damping at down-shifted frequency. Existing rf sources make this process a viable method for assisting the current ramp-up, and for heating the plasma of present large tokamaks.

35255 (PPPL—2329) Helicity content and tokamak applications of helicity. Boozer, A.H. (Princeton Univ., NJ (USA). Plasma Physics Lab.). May 1986. Contract AC02-76CH03073. 25p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86011364.

Magnetic helicity is approximately conserved by the turbulence associated with resistive instabilities of plasmas. To generalize the application of the concept of helicity, the helicity content of an arbitrary bounded region of space will be defined. The definition has the virtues that both the helicity content and its time derivative have simple expressions in terms of the poloidal and toroidal magnetic fluxes, the average toroidal loop voltage and the electric potential on the bounding surface, and the volume integral of E-B. The application of the helicity concept to tokamak plasmas is illustrated by a discussion of so-called MHD current drive, an example of a stable tokamak q profile with q less than one in the center, and a discussion of the possibility of a natural steady-state tokamak due to the bootstrap current coupling to tearing instabilities.

35256 (PPPL—2331) Analytic Grad-Shafranov test criteria and checks of a 1-1/2-D BALDUR code. Seidl, F.G.P. (Princeton Univ., NJ (USA). Plasma Physics Lab.). May 1986. Contract AC02-76CH03073. 85p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86011370.

As discussed by Shafranov, Solov'ev, and others, two special constraints allow the Grad-Shafranov equation to yield simple analytic solutions. From the simplest solution, formulae are derived for properties of the corresponding toroidally symmetric plasma and for the space profile of poloidal magnetic flux density. These formulae constitute test criteria for code performance once the code is made consistent with the two constraints. Obtaining consistency with the first constraint is straightforward, but with the second it is circumstantial. Moreover, the poloidal flux profile of the analytic solution implies a certain artificial form for the resistivity, which is also derived. These criteria have been used to check a composite code which had been assembled by linking a geometrically generalized 1-D BALDUR transport code with a computationally efficient 2-D equilibrium code. A brief description of the composite code is given as well as of its performance with respect to the Grad-Shafranov test criteria.

35257 (PPPL—2335) Evaluation of soft x-ray average recombination coefficient and average charge for metallic impurities in beam-heated plasmas. Sesnic, S.S.; Bitter, M.; Hill, K.W.; Hiroe, S.; Hulse, R.; Shimada, M.; Stratton, B.; von Goeler, S. (Princeton Univ., NJ (USA). Plasma Physics Lab.). May 1986. Contract AC02-76CH03073. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011163.

The soft x-ray continuum radiation in TFTR low density neutral beam discharges can be much lower than its theoretical value obtained by assuming a corona equilibrium. This reduced continuum radiation is caused by an ionization equilibrium shift toward lower states, which strongly changes the value of the average recombination coefficient of metallic impurities anti γ, even for only slight changes in the average charge, anti Z. The primary agent for this shift is the charge exchange between the highly ionized impurity ions and the neutral hydrogen, rather than impurity transport, because the central density of the neutral hydrogen is strongly enhanced at lower plasma densities with intense beam injection. In the extreme case of low density, high neutral beam power TFTR operation (energetic ion mode) the reduction in anti γ can be as much as one-half to two-thirds. We calculate the parametric dependence of anti γ and anti Z for Ti, Cr, Fe, and Ni impurities on neutral density (equivalent to beam power), electron temperature, and electron density. These values are obtained by using either a one-dimensional impurity transport code (MIST) or a zero-dimensional code with a finite particle confinement time. As an example, we show the variation of anti γ and anti Z in different TFTR discharges.

35258 (PPPL—2337) Microinstabilities in weak density gradient tokamak systems. Tang, W.M.; Rewoldt, G.; Chen, L. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Apr 1986. Contract AC02-76CH03073. 21p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86011168.

A prominent characteristic of auxiliary-heated tokamak discharges which exhibit improved ("H-mode type") confinement properties is that their density profiles tend to be much flatter over most of the plasma radius. Depsite this favorable trend, it is emphasized here that, even in the limit of zero density gradient, low-frequency microinstabilities can persist due to the nonzero temperature gradient.

35259 (PPPL—2338) Numerical study of stellarator transport. Hitchon, W.N.G.; Mynick, H.E. (Wisconsin Univ., Madison (USA). Dept. of Electrical and Computer Engineering; Princeton Univ., NJ (USA). Plasma Physics Lab.). May 1986. Contract AC02-76CH03073. 44p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86011359.

A detailed study of transport at low collision frequencies has been performed, using a numerical method of solution of the bounce-averaged Fokker-Planck equation which describes both ripple-trapped and non-ripple-trapped particles in a stellarator. Standard and "Transport-Optimised" Stellarators are studied, the latter for the first time at collision frequencies which are low enough for the effects of a radial electric field to be important. Comparisons with Monte Carlo calculations show excellent agreement, and although existing analytic methods of solution can strictly only be applied in rather limited regions, some extensions of analytic results are discussed which enable us to explain quantitatively the behavior observed.

35260 (PPPL—2339) SPRED spectrograph upgrade: high resolution grating and improved absolute calibrations. Stratton, B.C.; Fonck, R.J.; Ida, K.; Jaehnig, K.P.; Ramsey, A.T. (Princeton Univ., NJ (USA). Plasma Physics Lab.). May 1986. Contract AC02-76CH03073. 16p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86011167.

Two improvements to the SPRED multichannel VUV spectrographs used on the TFTR and PBX tokamaks have been made: (1) A new 2100-g/mm grating covering the 100 to 320 A region with 0.4 A resolution (FWHM) has been added to the existing 450 g/mm grating (100 to 1100 A with 2 A resolution), and (2) the TFTR SPRED has been absolutely calibrated using synchrotron radiation from the NBS SURF II facility, while the PBX system has been calibrated using conventional branching ratios along with line ratios from charge-exchange-recombination-excited lines. The availability of high resolution spectra in the 100 to 320 A range provides improved measurements of metallic ion emissions and, when the instrument views across a neutral beam as in PBX, allows carbon and oxygen densities to be measured via charge exchange recombination spectroscopy.

35261 (PPPL—2343) Influence of anomalous thermal losses of ignition conditions. Coppi, B.; Tang, W.M. (Princeton Univ., NJ (USA). Plasma Physics Lab.). May 1986. Contract AC02-76CH03073. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011369.

In the process of achieving ignition conditions, it is likely that microinstabilities, which lead to anomalous thermal transport of the fusing nuclei, will be present. When such phenomena are taken into account, an appropriate formulation of ignition criteria

becomes necessary. In particular, a new type of plasma density limit is identified.

35262 **(UCLA/PPG—902) Application of diffusion theory to neutral atom transport in fusion plasmas.** Hasan, M.Z.; Conn, R.W.; Pomraning, G.C. (California Univ., Los Angeles (USA). Dept. of Mechanical, Aerospace and Nuclear Engineering). May 1986. Contract AS03-80ER52062. 44p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86010913.

It is found that energy dependent diffusion theory provides excellent accuracy in the modelling of transport of neutral atoms in fusion plasmas. Two reasons in particular explain the good accuracy. First, while the plasma is optically thick for low energy neutrals, it is optically thin for high energy neutrals and diffusion theory with Marshak boundary conditions gives accurate results for an optically thin medium even for small values of 'c', the ratio of the scattering to the total cross section. Second, the effective value of 'c' at low energy becomes very close to one due to the downscattering via collisions of high energy neutrals. The first reason is proven both computationally and theoretically by solving the transport equation in a power series in 'c' and the diffusion equation with 'general' Marshak boundary conditions. The second reason is established numerically by comparing the results from a one-dimensional, general geometry, multigroup diffusion theory code, written for this purpose, with the results obtained using the transport code ANISN.

35263 **(UCLA/PPG—916) Two-dimensional finite element multigroup diffusion theory for neutral atom transport in plasmas.** Hasan, M.Z.; Conn, R.W. (California Univ., Los Angeles (USA). Dept. of Mechanical, Aerospace and Nuclear Engineering). Feb 1986. Contract FG03-86ER52130. 35p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86011441.

Solution of the energy dependent diffusion equation in two dimensions is formulated by multigroup approximation of the energy variable and general triangular mesh, finite element discretization of the spatial domain. Finite element formulation is done by Galerkin's method. Based on this formulation, a two-dimensional multigroup finite element diffusion theory code, FENAT, has been developed for the transport of neutral atoms in fusion plasmas. FENAT solves the multigroup diffusion equation in X-Y cartesian and R-Z cylindrical/toroidal geometries. Use of the finite element method allows solution of problems in which the plasma cross-section has an arbitrary shape. The accuracy of FENAT has been verified by comparing results to those obtained using the two-dimensional discrete ordinate transport theory code, DOT-4.3. Results of application of FENAT to the transport of limiter-originated neutral atoms in a tokamak fusion machine are presented.

35264 **(UCLA/PPG—941) Determination of gross plasma equilibrium from magnetic multipoles.** Kessel, C.E. (California Univ., Los Angeles (USA). Dept. of Mechanical, Aerospace and Nuclear Engineering). May 1986. Contract AS03-80ER52061. 31p. NTIS, PC A03/MF A01; 4; GPO Dep. File Number DE86010612.

A new approximate technique to determine the gross plasma equilibrium parameters, major radius, minor radius, elongation and triangularity for an up-down symmetric plasma is developed. It is based on a multipole representation of the externally applied poloidal magnetic field, relating specific terms to the equilibrium parameters. The technique shows reasonable agreement with free boundary MHD equilibrium results. The method is useful in dynamic simulation and control studies.

35265 **(UCLA/PPG—949) Effects of pressure anisotropy on plasma transport.** Zawaideh, E.; Najmabadi, F.; Conn, R.W. (California Univ., Los Angeles (USA). Dept. of Mechanical, Aerospace and Nuclear Engineering). Mar 1986. Contract AS03-80ER52062. 44p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86010613.

In a recent paper a new set of generalized two-field equations is derived which describes plasma transport along the field lines of a space and time dependent magnetic field. These equations are valid for collisional to weakly collisional plasmas; they reduce to the conventional fluid equations of Braginskii for highly collisional plasmas. An important feature of these equations is that the anisotropy in the ion pressure is explicitly included. In this paper, these generalized transport equations are applied to a model problem of plasma flow through a magnetic mirror field. The profiles of the plasma parameters (density, flow speed, and pressures) are numerically calculated for plasma in different collisionality regimes. These profiles are explained by examining the competing terms in the transport equation. The pressure anisotropy is found to profoundly impact the plasma flow behavior. As a result, the new generalized equations predict flow behavior more accurately than the conventional transport equations. A large density and pressure drop is predicted as the flow passes through a magnetic mirror. Further, the new equations uniquely predict oscillations in the density profile, an effect missing in results from the conventional equations.

35266 **Four-dimensional mapping model for two-frequency electron cyclotron resonance heating.** Howard, J.E.; Lichtenberg, A.J.; Lieberman, M.A.; Cohen, R.H. (California Univ., Berkeley, USA. Dept. of Electrical Engineering and Computer Sciences; California Univ., Berkeley, USA. Electronics Research Lab.; Lawrence Livermore National Lab., CA, USA). *Physica D: Nonlinear Phenomena (Amsterdam);* **20**: No. 2/3, 259-284(Jun-Jul 1986).

Two-frequency electron cyclotron resonance heating (ECRH) is modelled by a four-dimensional symplectic mapping derived from the nonrelativistic single particle equations of motion. The model includes changes in parallel energy due to the spatially separate resonance zones, not given by previous two-dimensional models. Fixed points are located and their linear stability limits determined. Resonances in action space are calculated along with their widths and used to obtain the adiabatic barrier to heating. Quasilinear diffusion coefficients are derived for the stochastic regime and found to agree well with numerical calculations. The primary diffusion in perpendicular energy can couple to the parallel motion, leading to diffusion in parallel energy. The resulting diffusion coefficient is calculated analytically and compared with numerical results. The much weaker Arnold diffusion along a resonance layer is also treated analytically, yielding diffusion coefficients in reasonable agreement with numerical values. (orig.).

35267 **Use of $^3HE^{30+}$ ICRF minority heating to simulate alpha particle heating.** Post, D.E. Jr.; Hwang, D.Q.; Hovey, J. (to Dept. of Energy, Washington, DC). US Patent 4,584,161. 22 Apr 1986. Filed date 16 Nov 1983. vp.

A method is described for simulating the behavior of energetic alpha particles produced in a magnetically confined first plasma wherein deuterium and tritium undergo fusion reactions. The method consists of: (a) producing a second plasma which includes deuterons and $^3He^{++}$ ions; (b) providing high energy radio frequency radiation to the second plasma for energizing the $^3He^{++}$ ions to an initial energy distribution closely approximating the energy distribution of the fusion-product alpha particles; and (c) detecting the energies of the $^3He^{++}$ ions, as the $^3He^{++}$ ions lose energy in the second plasma, the detected energies of the $^3He^{++}$ ions corresponding linearly to the energies of the alpha particles in the first plasma as the alpha particles slow down in energy, thereby simulating the energies of the alpha particles as they lose energy in the first plasma.

35268 **MOMCON: A spectral code for obtaining three-dimensional magnetohydrodynamic equilibria.** Hirshman, S.P.; Lee, D.K. (Oak Ridge National Lab., TN, USA). *Computer Physics Communications;* **39**: No. 2, 161-172(Feb-Mar 1986).

A new code, MOMCON (spectral moments code with constraints), is described that computes three-dimensional ideal magnetohydrodynamic (MHD) equilibria in a fixed toroidal domain using a Fourier expansion for the inverse coordinates (R, Z) representing nested magnetic surfaces. A set of nonlinear coupled ordinary differential equations for the spectral coefficients of (R, Z) is solved using an accelerated steepest descent method. A stream function, lambda, is introduced to improve the mode convergence properties of the Fourier series for R and Z. The convergence rate of the R-Z spectra is optimized on each flux surface by solving nonlinear con-

straint equations relating the m>=2 spectral coefficients of R and Z. (orig.).

35269 Apparatus for recording emissions from a rapidly generated plasma from a single plasma producing event. Tan, T.H.; Williams, A.H. (to Dept. of Energy, Washington, DC). US Patent 4,542,290. 17 Sep 1985. Filed date 24 Jan 1983. vp.
PAT-APPL-460529.

An optical fiber-coupled detector visible streak camera plasma diagnostic apparatus. Arrays of optical fiber-coupled detectors are placed on the film plane of several types of particle, x-ray and visible spectrometers or directly in the path of the emissions to be measured and the output is imaged by a visible streak camera. Time and spatial dependence of the emission from plasmas generated from a single pulse of electromagnetic radiation or from a single particle beam burst can be recorded.

35270 Study of microwave emission from a dense plasma focus. Gerdin, G.; Venneri, F.; Tanis, M. (Fusion Studies Lab., Univ. of Illinois, 103 S. Goodwin Ave., Urbana, IL). pp 5A-6 of IEEE conference record-abstracts of the 1985 IEEE international conference on plasma science. Piscataway, NJ; IEEE Service Center (1985). (CONF-850699—).

From Conference on plasma sciences; Pittsburgh, PA, USA (3 Jun 1985).

Microwave emission was detected in a 12.5 kJ dense plasma focus, using microwave horns and detectors placed in various locations outside the device. The results show that the parallel plates connecting the focus to its capacitor banks act as antennas and transmission lines, rather than wave guides. Subsequent measurements were performed with a microwave detector (R-band) attached to the focus anode, directly looking into the coaxial gun region, allowing to restrict the microwave emitting region to the muzzle end of the focus. The microwave frequency spectrum, determined with a time of flight detection system, strongly suggests the lower hybrid instability as the driving mechanism of the emissions. Comparing the time sequence of the emissions with those of other observable phenomena in the focus, a model was developed, to explain the possible relationship between the generation of microwave radiation and turbulence induced resistivity in the focus pinch. According to the model, microwaves and enhanced resistivity are caused by current driven instabilities occurring in the current sheath produced at the outer boundary of the pinch during the initial compression phase. Comparisons of the model predictions with observed experimental results are presented, including time resolved measurements of the pinch resistivity.

35271 A stereoscopic pinhole camera study of plasma focus produced ion beam. Schneider, R.F.; Rhee, M.J. (Lab. for Plasma and Fusion Energy Studies, Univ. of Maryland, College Park, MD). pp 5A-5 of IEEE conference record-abstracts of the 1985 IEEE international conference on plasma science. Piscataway, NJ; IEEE Service Center (1985). (CONF-850699—).

From Conference on plasma sciences; Pittsburgh, PA, USA (3 Jun 1985).

A stereoscopic pinhole camera is used to investigate the ion source in a plasma focus. The plasma focus device consists of a parallel arrangement of four 15 μF, 20 kV capacitors which are typically charged to 10 kV yielding a peak plasma current of 200 kA. The coaxial Mather geometry plasma gun consists of a center electrode (anode) which is a 2.5 cm diameter hollow copper pipe, and a squirrel cage outer electrode (cathode) which consists of twelve evenly spaced 3 mm diameter copper rods on a 7.5 cm diameter. Filling gases He and Ar with pressures in the 0.1 to 1.0 Torr range are investigated. The pinhole camera is made of two pinholes (75 microns) separated by 10 mm. CR-39 nuclear track detector is placed 15 mm downstream of the pinholes. When the plasma focus device is fired, two pinhole images are exposed on the detector, each of the images having a different perspective of the ion source. Assuming the ion source emits uniformly in the small angel subtended by the pinholes (typically about 7 degrees) it is easy to show that a three dimensional reconstruction of the ion source may be produced from the two images on the CR-39. A simple advancing mechanism is used which enables up to five exposures on a 2.5 x 5 cm piece of CR-39 without breaking vacuum. A typical object: image size ratio is 5:1 and a typical object resolving power is 0.3 mm in this pinhole system. Results indicate the ion source is spread over a region comparable to the diameter of the center electrode in the plasma gun. Detailed experimental results and analysis of stereoscopic images are presented.

35272 Hydromagnetic Rayleigh-Taylor instability in cylindrical implosions. Hwang, C.S.; Roderick, N.F. (Univ. of New Mexico, Albuquerque, NM). pp 5R-3 of IEEE conference record-abstracts of the 1985 IEEE international conference on plasma science. Piscataway, NJ; IEEE Service Center (1985). (CONF-850699—).

From Conference on plasma sciences; Pittsburgh, PA, USA (3 Jun 1985).

Models have been developed to study the hydromagnetic equivalent of the Rayleigh-Taylor instability in cylindrical plasmas. Two types of models have been formulated to extend previous planar descriptions: a potential flow model and a snowplow model. The potential flow model is a cylindrical version of the Plessett (1) model used to describe the stability of spherical bubbles. This description allows estimates to be made of the linear growth of the instability in the r-θ plane. The snowplow models allow estimation of instability growth during the early phases of plasma liner implosions and throughout most of the implosion phase of many gas puff implosions. Solutions are presented for typical implosion parameters for both types of processes.

35273 RF emission power and its dependence on plasma parameters and turbulence in a classical penning discharge. Laroussi, M.; Spence, P.D.; Rosenberg, D.; Mannone, J.C.; Roth, J.R. (UTK Plasma Science Laboratory, Department of Electrical Engineering, University of Tennessee, Knoxville, TN). pp 5P-3 of IEEE conference record-abstracts of the 1985 IEEE international conference on plasma science. Piscataway, NJ; IEEE Service Center (1985). (CONF-850699—).

From Conference on plasma sciences; Pittsburgh, PA, USA (3 Jun 1985).

The authors operated a steady-state classical Penning discharge in a uniform axial magnetic field, the value of which can be varied up to 0.4 Tesla. The electron number density is typically 2 $10^9/cm^3$ in helium gas with Te = 5 - 10 eV. RF emission has been detected with specially developed broad-band planar-spiral and conical-spiral antennas, and its absolute integral power has been measured and plotted against electron number density and electron kinetic temperature, with the magnetic field as a parameter. The electron number density and kinetic temperature have been measured with a Langmuir probe inserted into the plasma. The RF emission spectrum covers a broad-band frequency range between 100 MHz and 1000 MHz. This spectrum is formed by numerous harmonics of fundamental frequencies. The correlation between the RF emission spectra and the results already obtained on the electrostatic turbulence due to strong axial and radial electric fields and on wave propagation in the plasma is also investigated.

35274 Anisotropy of the energy spectrum of plasma focus ion beams. Luo, C.M.; Nardi, V.; Powell, C. (Stevens Inst. of Tech., Hoboken, NJ). pp 5A-3 of IEEE conference record-abstracts of the 1985 IEEE international conference on plasma science. Piscataway, NJ; IEEE Service Center (1985). (CONF-850699—).

From Conference on plasma sciences; Pittsburgh, PA, USA (3 Jun 1985).

The authors have determined the energy spectrum Nα/sub(E)dE of the ion beams emitted in different directions (α) with respect to the the electrode axis (α=0°,90°,180°) of a plasma focus discharge (PF) ($\approx$5 kJ at 20 kV),filling pressure 4 Torr of D_2/ or of convenient H_2+D_2 mixtures. They have used Thomson spectrometers for ion-energies E$\approx$70 keV-1 MeV (all α) and a high resolution magnetic analyzer with field-edge focusing and ion filtering for E$\approx$0.3-8 MeV (α=0°). The typical spectral amplitude N_{180}dE of the ion beam at 180° (i.e.,in the direction in which the PF pinch ejects a collimated $\approx$ 10 kA beam of $\approx$400 keV electrons) is smaller than N_0dE with typical values N_0(0.3 MeV)/N_{180}(0.3 MeV)$\approx$ 100 but has a relatively stronger component of high energy ions

N_{180}(0.8 MeV)/N_{180}(0.1 MeV) > 10 N_0(0.8 MeV)/N(0.1 MeV). The source brightness is reported for different α. The angular spread of the 180° ion beam decreases for increasing energy values and is $<<1°$ for E≧0.5 MeV. The spectral resolution δE/E of the magnetic analyzer is better than 1% for 1 MeV ≦ E ≦7 MeV and that of the Thomson spectrometer ≈ 10% for E ≈0.1 - 0.8 MeV.

35275 **Acceleration of M/Z>2 particles in deuterium focused discharges.** Nardi, V.; Powell, C. (Stevens Inst. of Tech., Hoboken, NJ). pp 5A-4 of IEEE conference record-abstracts of the 1985 IEEE international conference on plasma science. Piscataway, NJ; IEEE Service Center (1985). (CONF-850699—).

From Conference on plasma sciences; Pittsburgh, PA, USA (3 Jun 1985).

The energy spectrum and the fractional composition of M/Z≧ 2 particle beams accelerated along the electrode axis of a plasma focus discharge (4-6 Torr,D_2 filling) are obtained with a high resolution magnetic analyzer and ion differential filtering. The population of high-Z fully-stripped ions (e.g.,C,N,O) with energy E>1 MeV is a nearly constant fraction (≈10%) of the beam particles in different shots. Pinhole images of the beam source from particle emission and x-ray (2-5 keV) bremsstrahlung emission are also obtained from different directions for consistency tests on the impurity-density value within the source. The probability of formation of ion clusters with M/Z > 2-200 is assessed from these data.

35276 **Summary abstract: measurement of the ionization length for neutral iron near the wall in the ISX-B tokamak using laser-induced fluorescence.** Cook, T.B.; King, P.W.; Roberto, J.B. (Oak Ridge National Lab., TN). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 2: No. 2, 707-708(Apr-Jun 1984). Contract W-7405-ENG-26.

It is widely recognized that fusion reactor operation will be adversely affected by even small amounts of high-Z contaminants. An important source of such impurities is the first wall, which is subject to high power and particle loadings that can result in significant release of metal atoms into the plasma. Measurement of the impurity content of plasmas is commonplace, and the transport of high-Z materials in the core plasma has been studied at length. However, little experimental work has been performed in tokamaks to study the transport of eroded wall material through the edge plasma and into the core. The first direct measurements of the decrease in neutral metal density due to ionization in the edge plasma as a function of distance from the first wall in a tokamak are reported. Such measurements are sensitive to impurity introduction mechanisms and edge plasma parameters. The results were obtained using the laser-induced fluorescence technique and are consistent with previous reports which suggest heavy impurity introduction in ISX-B by wall sputtering.

35277 **Fusion; An introduction to the physics and technology of magnetic confinement fusion.** Stacey, W.M. New York, NY; John Wiley and Sons (1984). 260p. John Wiley & Sons, Inc., 605 Third Avenue, New York, NY 10150.

This book is suitable as a text for an introductory course on magnetic fusion and technology for advanced undergraduate or graduate students. It includes chapter problems, a reading list, appendices with physical constants and conversion factors, and a subject index. Contents, abridged: Basic properties. Confinement concepts. Plasma heating. Magnetics. Energy storage and transfer. Index.

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REFER ALSO TO CITATION(S) 34275, 34313, 34314, 34482, 34558, 34581, 35233, 35234, 35235, 35242, 35243

35278 **(AD-A—163604/2/XAB) Laser interaction in long-scalelength plasmas. Interim report.** Gardner, J.H.; Herbst, F.C.; Young, M.J.; Stamper, J.A.; Obenschain, S.P. (Naval Research Lab., Washington, DC (USA)). 31 Dec 1985. 65p. (NRL-MR—5651). NTIS, PC A04/MF A01.

Absorption of a short-pulse, high-intensity Nd-laser beam (vacuum irradiance of 10^{14} to 10^{15} W/sq cm) by preformed plasmas of different density scalelengths is investigated. Increased effects of plasma instabilities are found at longer scalelengths. The amount of backscattered light increases with plasma scalelength and limits the absorption fraction at the longest scalelength. The onset of suprathermal electron production, deduced from observations of energetic (20- to 50-keV) x rays, occurs at lower laser irrradiance for longer scalelength plasmas. A correlation between energetic x rays and 3 omega sub 0/2 emission suggests that the suprathermal electrons are produced by a plasma instability at quarter-critical density. At higher intensities there is evidence for severe perturbations of the preformed plasma and for self-focusing of the incident beam.

35279 **(AD-A—163867/5/XAB) Ultraviolet laser shadowgraphy system for the Shiva-star fast-capacitor bank. Final report, 5 November 1984-30 June 1985.** (Air Force Weapons Lab., Kirtland AFB, NM (USA)). Nov 1985. 23p. (AFWL-TR—85-82). NTIS, PC A02/MF A01.

An ultraviolet laser shadowgraphy was developed that is sensitive to plasma densities in the few 10^{16}/cu cm regime. It is fast enough (< 10 ns exposure time) to freeze the motion of even fast-moving plasmas, and it is capable of operating in an environment where there is a high level of both background light and electrical noise. System setup and adjustments as well as interpretation of data from a coaxial-geometry experiment are discussed.

35280 **(ANL/TM—435) CCP-NAP operator instructions at ANL.** Tantillo, V.V. (Argonne National Lab., IL (USA)). Mar 1986. Contract W-31-109-ENG-38. 94p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86010968.

CCP-NAP Operator Instructions at ANL (ANL/TM 435) supplements the CCPGUIDE (Category 26) prepared by the National Magnetic Fusion Energy Computer Center (NMFECC), Lawrence Livermore National Laboratory. The instructions in CCP-NAP Operator Instructions at ANL serve as a reference guide for Computing Services operators when operator intervention is necessary for ANL's MFEnet Nodes located in Building 221, Room A-134. Use this document in conjunction with the CCPGUIDE. The CCPGUIDE, a guide for network operators, outlines the procedures for loading the Communications Control Processor (CCP) and monitoring its activity. The CCPGUIDE contains detailed information on Software Loading, System Status, System Monitoring, Command Summary, etc. The material in this document is the result of additional information provided by Jim Morton and Jim Gigliaridi (NMFECC) when our Argonne National Laboratory/Computing Services MFEnet Nodes were installed. This document provides two formats: QUICK instructions and procedures, and detailed general text.

35281 **(CONF-851102—109) Performance and cost sensitivities associated with superconducting devices.** Selcow, E.C.; Brown, T.G.; Flanagan, C.A. (Grumman Aerospace Corp., Princeton, NJ (USA); Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011064.

From 11. symposium on engineering problems in fusion research; Austin, TX, USA (18 Nov 1985).

This paper describes the results of a study to explore the design space of superconducting ignition devices. Parametric studies were performed with the revised FEDC Tokamak Systems Code to determine the sensitivity of performance and cost variations in confinement model, aspect ratio, maximum field at the toroidal field (TF) coils, and plasma elongation. We discuss the methodology employed and the implication of the results obtained.

35282 **(CONF-860421—42) New ideas in dosimetry and damage calculations for fusion materials irradiations.** Greenwood, L.R. (Argonne National Lab., IL (USA)). 1986. Contract W-31-109-ENG-38. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010505.

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

Nuclear data and techniques are being developed to improve our ability to characterize fusion materials irradiations in terms of neutron fluence and spectra as well as damage parameters such as atomic displacements, gas production, and other transmutation. The

production of long-lived isotopes are being measured near 14 MeV, including reactions from Al, Fe, and Mo to ^{28}Al, ^{52}Mn, and ^{94}Nb, and measurements for other reactions are in progress. These data can be used for fusion reactor dosimetry, plasma diagnostics, and the estimation of radioactivity in fusion reactor materials. Dosimetry cross sections are being measured for fission reactors using Be(d,n) sources (E/sub d/= 7 to 40 MeV) and monoenergetic neutron sources from 1 to 14 MeV. These data can be used to adjust activation cross sections. Spallation cross sections are being measured for higher-energy accelerator neutron sources. Helium production cross sections are being tested at all fusion irradiation facilities. We have recently discovered a new thermal helium production in copper, similar to the well-known effect in nickel. Recommended procedures have been published for the calculation of helium from both copper and nickel in mixed-spectrum reactors. A new program SPECOMP has recently been developed to calculate displacement damage for compounds. This program uses the SPECTER recoil atom distributions and integrates over secondary displacement functions for each combination of incident ion and matrix material to determine displacement cross sections for alloys, insulators, and breeder materials.

35283 **(CONF-860522—8) Residual effects of chromium gettering on the outgassing behavior of a stainless steel vacuum vessel.** Simpkins, J.E.; Blanchard, W.R.; Dylla, H.F.; LaMarche, P.H. (Oak Ridge National Lab., TN (USA); Princeton Univ., NJ (USA). Plasma Physics Lab.). May 1986. Contract AC05-84OR21400. 15p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86011509.

From 7. international conference on plasma surface interactions in controlled fusion devices; Princeton, NJ, USA (5 May 1986).

Laboratory experiments that compared chromium and titanium gettering showed that with chromium, unlike titanium, there is no appreciable diffusion of hydrogen isotopes into the film. It was concluded from these experiments that chromium gettering on tokamaks is more desirable than titanium gettering, since chromium should provide higher hydrogen recycling, minimize tritium inventories, and avoid hydrogen embrittlement. Large-scale sublimation sources, consisting of hollow elongated chromium spheres with internal resistance heaters, were developed for use on tokamaks. These sources have been used to getter both the Impurity Study Experiment (ISX) and the Tokamak Fusion Test Reactor (TFTR). In both bases, significant effects on plasma performance were observed, including lower Z/sub eff/ and radiated power losses and an increase in the density limit. In TFTR these effects were observed for a period of weeks after a single chromium deposition. This paper reports the results of laboratory experiments made to examine the gettering characteristics of chromium films under conditions simulating those in TFTR.

35284 **(CONF-860522—9) Pump limiter studies on the Heliotron-E device.** Hillis, D.L.; Mioduszewski, P.K.; Zuhr, R.A.; Clausing, R.E.; Baity, F.W.; Fowler, R.H.; Rome, J.A.; Motojima, O.; Mitzuuchi, T.; Mutoh, T.. (Oak Ridge National Lab., TN (USA); Kyoto Univ., Uji (Japan). Plasma Physics Lab.). May 1986. Contract AC05-84OR21400. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011500.

From 7. international conference on plasma surface interactions in controlled fusion devices; Princeton, NJ, USA (5 May 1986).

Particle control with pump limiters has been successfully demonstrated in a variety of tokamaks. This experiment has obtained, for the first time, experimental data on pump limiter operation in a heliotron configuration. A movable pump limiter module was installed on a horizontal midplane port of Heliotron-E. The limiter assembly consists of a TiC-coated graphite head with single-sided particle collection and active pumping. The location of the limiter is varied from near the vacuum vessel wall or up to 8 cm inside the last closed magnetic flux surface. This flexibility permits the study of a heliotron plasma that is limited either by the magnetic separatrix or by a material limiter. In the configuration investigated, only very low pressures are observed in the pump limiter when it is located outside the last closed flux surface, indicating that the scrape-off layer density is very low ($<5 \times 10^{11} cm^{-3}$). For limiter positions inside the last closed flux surface, pressures of 2 to 6 mTorr are observed (similar to comparable tokamak operation). Erosion patterns on the vacuum vessel, as well as hot spots on the limiter head, indicate that the particle flow out of the confined plasma exhibits complicated patterns.

35285 **(CONF-860743—2) RFTF ECH microwave system.** Bigelow, T.S.; White, T.L.; Kimrey, H.D. (Oak Ridge National Lab., TN (USA)). 1986. Contract AC05-84OR21400. 3p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86010030.

From 21. microwave power symposium; Memphis, TN, USA (28 Jul 1986).

A Radio-Frequency Test Facility (RFTF) has recently been constructed at Oak Ridge National Laboratory (ORNL) for development and testing of Ion Cyclotron Heating (ICH) antennas under realistic fusion reactor plasma edge conditions. High-power ICH antennas must be immersed in the plasma for proper coupling of rf power and therefore are subject to particle bombardment and heat flux. In RFTF, plasma is generated and heated by electron cyclotron resonance heating (ECRH) with 28-GHz microwave power from a gyrotron tube. The plasma is confined in a simple magnetic mirror formed by two superconducting coils surrounding a box-shaped vacuum vessel. Using 50 kW of microwave power, a plasma with density of 5×10^{11} cm^3 and temperature of 8 eV is obtained, a fairly good fusion research edge plasma. This presentation covers the microwave generation and transmission system plus some of the electron cyclotron heated (ECH) results on RFTF.

35286 **(DOE/ER/13449—1) Investigation of parameters critical to muon-catalyzed fusion. Annual performance report, 1985-1986.** Jones, S.E. (Brigham Young Univ., Provo, UT (USA). Dept. of Physics and Astronomy). 13 May 1986. Contract FG02-85ER13449. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011460.

Muon catalysis cycling rates have been shown to increase rapidly with increasing deuterium-tritium gas temperatures and densities. Furthermore, muon-capture losses decrease sharply as the fluid density is raised. As a result of these effects, we have been able to achieve muon-catalyzed fusion yields of over 170 fusions/muon (average). The fusion energy thereby released, 3 GeV/muon, significantly exceeds theoretical expectations and higher yields are expected. Therefore, we are exploring the limits of muon-catalyzed fusion, to provide answers to questions regarding energy applications of muon-catalyzed fusion.

35287 **(DOE/ER/13449—T2) Experiments in cold fusion.** Palmer, E.P. (Brigham Young Univ., Provo, UT (USA). Dept. of Physics and Astronomy). 28 Mar 1986. Contract FG02-85ER13449. 4p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86011571.

The work of Steve Jones and others in muon-catalyzed cold fusion of deuterium and hydrogen suggests the possibility of such fusion catalyzed by ions, or combinations of atoms, or more-or-less free electrons in solid and liquid materials. A hint that this might occur naturally comes from the heat generated in volcanic action in subduction zones on the earth. It is questionable whether the potential energy of material raised to the height of a midocean ridge and falling to the depth of an ocean trench can produce the geothermal effects seen in the volcanoes of subduction zones. If the ridge, the trench, the plates, and the asthenosphere are merely visible effects of deeper density-gradient driven circulations, it is still uncertain that observed energy-concentration effects fit the models.

35288 **(DOE/ER/53198—90) Electrical circuit modeling of conductors with skin effect.** Kerst, D.W.; Sprott, J.C. (Wisconsin Univ., Madison (USA)). Mar 1986. Contract FG02-85ER53198. 40p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86011085.

The electrical impedance of a lossy conductor is a complicated function of time (or frequency) because of the skin effect. By solving the diffusion equation for magnetic fields in conductors of several prototypical shapes, the impedance can be calculated as a function of time for a step function of current. The solution suggests an electrical circuit representation that allows calculation of time-dependent voltages and currents of arbitrary waveforms. A

technique using an operational amplifier to determine the current in such a conductor by measuring some external voltage is described. Useful analytical approximations to the results are derived.

35289 (EUR-CEA-FC—1243) **High energy neutral atom injection from positive ions. Development proposal. I. Principles. II. Injection design.** Druaux, J. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Recherches sur la Fusion Controlee). Jun 1985. 56p. (In French). NTIS (US Sales Only), PC A04/MF A01. File Number DE86751881.

For reactor type Tokamak devices, the energy necessary for a good penetration is such than the neutralization efficiency with an ordinary gas D_2 is very weak. Improvement is possible without using negative ions or heavy ions. These possibilities are presented and discussed in this study, which is peculiarly aimed at one of them the recycling of non neutralized ions.

35290 (IAE—4034/8) **Forced cooled ion-optical systems of stationary multiampere ion sources.** Semashko, N.N.; Pleshivtsev, N.V.; Malakhov, N.P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1984. 25p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE86702122.

Problems of developing electrodes of ion-optical systems (IOS) of stationary multiampere ion sources (IS) of megawatt deuterium atom beam injectors for thermonuclear reactors were considered. Selection of IOS element materials was substantiated. Technology fabrication electrodes of pulse (10-300 As) and stationary IS and IS element soldering with solders containing no silver were considered as well. Ways for producing profile elements (solid and hollow) from round blanks and for eliminating defects of hollow profiles by the tungsten precipitation method from gas phase are described. Reliability of IOS electrodes of 4604 molybdenum alloy under conditions of the ion source of the IBM and IPM types with 30-100 A current and 10-25 keV energy in the T-11, Ogra-3, Ogra-4 thermonuclear facilities and in injectors of powerful neutral beams has been proved experimentally.

35291 (IPP—III/107, pp 3-15) **Confinement in ASDEX with neutral beam and RF heating.** Keilhacker, M.; Gierke, G. v.; Mueller, E.R.; Murmann, H.; Soeldner, F.; Speth, E.; Steinmetz, K.; Wagner, F.; Becker, G.; Bosch, H.S. (Association Euratom-Max-Planck-Institut fuer Plasmaphysik, Garching, Germany, F.R.; Comitato Nazionale per l'Energia Nucleare, Frascati, Italy; CEA Centre d'Etudes Nucleaires de Grenoble, 38, France). Nov 1985. NTIS (US Sales Only), PC A05/MF A01. File Number DE86752047. (CONF-850927—Exc.).

From 12. European conference on controlled fusion and plasma physics; Budapest, Hungary (2 Sep 1985).

Neutral beam (NI), ion cyclotron resonance (ICRH) and lower hybrid resonance (LHRH) heating on ASDEX are discussed with regard to their effect on plasma confinement. Comparison of NI and ICRH shows that the L and H-regimes are universal confinement modes of auxiliary-heated tokamak plasmas (i.e. independent of the heating method), and that the edge electron temperature (or a related parameter) dictates which mode prevails. In this connection it is noted that carbonization of the vessel walls impedes transition to the H-mode in the case of NI heating. Studies of energy confinement in the intermediate regime from ohmic to NI heating reveal a gradual transition from ohmic (proportionalanti nsub(e)) to neutral injection L-mode (proportionall) scaling. At the same time a remarkable invariance of electron temperature profile shape with increasing heating power is observed. Changing the NI power deposition profiles from central to off-axis leaves gross energy confinement times unchanged while central confinement is substantially improved. Detailed investigations of the β-limit confirm the relation βsub(max)sup(dia) [%] = 2.8 I/(a B) [MA . m^{-1} . T^{-1}]. They show that the β-limit is independent of heating method (NI, ICRH) and confinement regime (L or H), but stronlgy dependent on the current density profile. Indirect evidence suggests ballooning (and possibly surface kink) modes to be responsible for the limitation in plasma pressure. LH heating and current drive show improved energy confinement (compared to OH) at low densities (anti nsub(e) <= 1 - 2 . 10^{13} cm^{-3}, suprathermal electrons), but a degradation in confinement at higher densities. (orig.).

35292 (IPP—III/107, pp 16-20) **Confinment studies on ASDEX in the intermediate region from Ohmic to neutral injection scaling.** Wagner, F.; Gruber, O.; Becker, G.; Bosch, H.S.; Eberhagen, A.; Fussmann, G.; Gehre, O.; Gernhardt, J.; Gierke, G. v.; Glock, E. (Association Euratom-Max-Planck-Institut fuer Plasmaphysik, Garching, Germany, F.R.; Comitato Nazionale per l'Energia Nucleare, Frascati, Italy; AN SSSR, Leningrad. Fiziko-Tekhnicheskij Inst.; Nuclear Development Corp. of South Africa, Pty. Ltd., Pelindaba, Pretoria; CEA Centre d'Etudes Nucleaires de Grenoble, 38, France). Nov 1985. NTIS (US Sales Only), PC A05/MF A01. File Number DE86752047. (CONF-850927—Exc.).

From 12. European conference on controlled fusion and plasma physics; Budapest, Hungary (2 Sep 1985).

The scaling of the global energy confinement time with density and plasma current is studied in the intermediate region from Ohmic to neutral injection L-scaling with beam power Psub(NL)proportional(1-3) x Psub(OH). A gradual transition from Ohmic to neutral injection L-scaling is found. The results can be described by quadratically adding the Ohmic- and L-scaling characteristics indicating that the L-scaling may be the continuation of Ohmic scaling towards higher power and that non-local properties determine the transport. (orig.).

35293 (IPP—III/107, pp 21-24) **Effect of neutral beam deposition on heating and confinement in ASDEX.** Speth, E.; Eberhagen, A.; Gehre, O.; Gernhardt, I.; Janeschitz, G.; Mueller, E.R.; Staebler, A.; Vollmer, O.; Wagner, F.; Bartiromo, R. (Association Euratom-Max-Planck-Institut fuer Plasmaphysik, Garching, Germany, F.R.). Nov 1985. NTIS (US Sales Only), PC A05/MF A01. File Number DE86752047. (CONF-850927—Exc.).

From 12. European conference on controlled fusion and plasma physics; Budapest, Hungary (2 Sep 1985).

The effect of the beam deposition profile on heating and confinement in ASDEX has been studied by comparing plasmas with center-peaked and hollow beam deposition profiles. There is no significant difference in global energy confinement time and central electron energy density. A hollow deposition profile reduces the central electron heat transport at least by a factor of two. A beam energy of 75 keV/nucleon would be sufficient in order to generate the same (a/lambda = const.) deposition profile for a full-density, full-bore scenario in NET. (orig./GG).

35294 (IPP—III/107, pp 25-28) **Radial energy balance analysis of ASDEX H-mode discharges.** Gruber, O.; Jilge, W.; Bernhardi, K.; Eberhagen, A.; Fussmann, G.; Gehre, O.; Gernhardt, J.; Gierke, G. v.; Glock, E.; Haas, G. (Association Euratom-Max-Planck-Institut fuer Plasmaphysik, Garching, Germany, F.R.). Nov 1985. NTIS (US Sales Only), PC A05/MF A01. File Number DE86752047. (CONF-850927—Exc.).

From 12. European conference on controlled fusion and plasma physics; Budapest, Hungary (2 Sep 1985).

Radial transport and confinement properties of ELM dominated (H) and ELM free (H*) beam heated ASDEX-discharges are studied using the PPPL transport analysis code TRANSP. For similar plasma parameters the H* discharges have energy confinement times of about 1.5 as large as those in H discharges and correspondingly reduced electron heat diffusivities due to the absence of the ELM's. Electron conductive losses dominate the energy losses besides radiation cooling. (orig.).

35295 (IPP—III/107, pp 45-48) **Quasi stationary D_2 pellet injection into ASDEX divertor discharges.** Vlases, G.; Kaufmann, M.; Gruber, O.; Haas, G.; Lang, R.S.; Buechl, K.; Sandmann, W. (Washington Univ., Seattle, USA; Association Euratom-Max-Planck-Institut fuer Plasmaphysik, Garching, Germany, F.R.). Nov 1985. NTIS (US Sales Only), PC A05/MF A01. File Number DE86752047. (CONF-850927—Exc.).

From 12. European conference on controlled fusion and plasma physics; Budapest, Hungary (2 Sep 1985).

We report on deuterium divertor discharges in ASDEX where the particle inventory is sustained entirely, after an initial gas

fuelling phase, by the injection of a series of up to 80 frozen D_2 pellets, 1 mm in diameter and 1.2 mm long (Nsub(D) <= 4.5 x 10^{19}), at intervals ranging from 20 to 50 ms, and speeds to 720 m/s, by means of a centrifuge. Investigations performed on Ohmic, NI, and ICRH heated discharges have shown that the most important parameter characterizing the discharges is the ratio of the pellet penetration depth to the fall-off length for neutral particles in a gas fuelled case (typically 5-8 cm in ASDEX). (orig./GG).

35296 (IPP—III/107, pp 49-52) **Impurity sources during ohmic-heated discharges in ASDEX.** Roth, J.; Fussmann, G.; Janeschitz, G.; Verbeek, H.; Wagner, F.; Bartiromo, R.; Becker, G.; Bosch, H.S.; Eberhagen, A.; Ertl, K. (Association Euratom-Max-Planck-Institut fuer Plasmaphysik, Garching, Germany, F.R.). Nov 1985. NTIS (US Sales Only), PC A05/MF A01. File Number DE86752047. (CONF-850927—Exc.).

From 12. European conference on controlled fusion and plasma physics; Budapest, Hungary (2 Sep 1985).

Impurity control, especially during auxiliary heating, is still one major issue in fusion devices. Though it has been possible to reduce considerably the heavy impurity level in the ohmic phase, either by appropriate choice of wall and limiter materials or by using divertors, their origin is still under discussion. The contribution of charge exchange (CX) neutral sputtering at the wall can be examined by changing the working gas from hydrogen to helium, where CX cross sections are much lower. The contribution of ion sputtering can be investigated by comparison of divertor and carbon limiter discharges. (orig.).

35297 (IPP—III/107, pp 53-56) **Poloidal asymmetric impurity radiation in ASDEX in the presence of neutral injection.** Feneberg, W.; Kornherr, M.; Smeulders, P.; Becker, G.; Bosch, H.; Brocken, H.; Eberhagen, A.; Fussmann, G.; Gehre, O.; Gernhardt, J. (Association Euratom-Max-Planck-Institut fuer Plasmaphysik, Garching, Germany, F.R.; Comitato Nazionale per l'Energia Nucleare, Frascati, Italy; Nuclear Development Corp. of South Africa, Pty. Ltd., Pelindaba, Pretoria; CEA Centre d'Etudes Nucleaires de Grenoble, 38, France; Washington Univ., Seattle, USA). Nov 1985. NTIS (US Sales Only), PC A05/MF A01. File Number DE86752047. (CONF-850927—Exc.).

From 12. European conference on controlled fusion and plasma physics; Budapest, Hungary (2 Sep 1985).

During high power neutral beam injection (NI) in ASDEX large poloidal asymmetries in the impurity radiation are observed. Dependent on the confinement regime vertical asymmetries are found in energy and particle fluxes in top and bottom divertors and are also measured in the main chamber by VUV-spectroscopy, by bolometer and ultra-soft-X-ray (USX-) pinhole cameras. These measurements are all performed in the vertical plane. By means of a second USX-camera mounted nearly on top of the divertor tokamak also horizontal asymmetries are detected, which become especially pronounced in the H-regime during high power NI (3.4 MWatt). (orig./GG).

35298 (IPP—III/107, pp 57-60) **Retainment of gaseous and target produced impurities in the ASDEX divertor.** Janeschitz, G.; Fussmann, G.; Roth, J.; Taglauer, E.; Becker, G.; Bosch, H.S.; Eberhagen, A.; Gehre, O.; Gernhardt, J.; Gierke, G. v. (Association Euratom-Max-Planck-Institut fuer Plasmaphysik, Garching, Germany, F.R.; Nuclear Development Corp. of South Africa, Pty. Ltd., Pelindaba, Pretoria; GA Technologies, Inc., San Diego, CA, USA; Comitato Nazionale per l'Energia Nucleare, Frascati, Italy; AN SSSR, Leningrad. Fiziko-Tekhnicheskij Inst.). Nov 1985. NTIS (US Sales Only), PC A05/MF A01. File Number DE86752047. (CONF-850927—Exc.).

From 12. European conference on controlled fusion and plasma physics; Budapest, Hungary (2 Sep 1985).

In this paper we report on experiments performed to investigate the retainment capability of the divertor for gaseous recycling impurities and for metallic impurities produced by sputtering at the neutralizer plates. For quantitative analyses the experiments are simulated by a one dimensional transport code, including a simple divertor model. (orig./GG).

35299 (IPP—III/107, pp 61-64) **Impurity behaviour for various auxiliary heating methods in ASDEX.** Fussmann, G.; Janeschitz, G.; Mueller, E.R.; Soeldner, F.; Bosch, H.S.; Eberhagen, A.; Gehre, O.; Gernhardt, J.; Gierke, G. v.; Glock, E. (Association Euratom-Max-Planck-Institut fuer Plasmaphysik, Garching, Germany, F.R.; Comitato Nazionale per l'Energia Nucleare, Frascati, Italy; Nuclear Development Corp. of South Africa, Pty. Ltd., Pelindaba, Pretoria; AN SSSR, Leningrad. Fiziko-Tekhnicheskij Inst.; GA Technologies, Inc., San Diego, CA, USA). Nov 1985. NTIS (US Sales Only), PC A05/MF A01. File Number DE86752047. (CONF-850927—Exc.).

From 12. European conference on controlled fusion and plasma physics; Budapest, Hungary (2 Sep 1985).

Three different additional heating methods are being applied in the ASDEX divertor tokamak: neutral injection (NI), ion cyclotron heating (ICRH) at the 2nd harmonic of hydrogen, and lower hybrid heating (LH). In this paper we discuss the impurity behaviour observed for three heating scenarios. (orig./GG).

35300 (IPP—III/107, pp 65-68) **High power ICRF heating on the divertor tokamak ASDEX.** Steinmetz, K.; Fussmann, G.; Gruber, O.; Niedermeyer, H.; Mueller, E.R.; Wagner, F.; Wesner, F.; Braun, F.; Hofmeister, F.; Noterdaeme, J.M. (Association Euratom-Max-Planck-Institut fuer Plasmaphysik, Garching, Germany, F.R.; CEA Centre d'Etudes Nucleaires de Grenoble, 38, France; Comitato Nazionale per l'Energia Nucleare, Frascati, Italy; AN SSSR, Leningrad. Fiziko-Tekhnicheskij Inst.; Nuclear Development Corp. of South Africa, Pty. Ltd., Pelindaba, Pretoria). Nov 1985. NTIS (US Sales Only), PC A05/MF A01. File Number DE86752047. (CONF-850927—Exc.).

From 12. European conference on controlled fusion and plasma physics; Budapest, Hungary (2 Sep 1985).

First ICRF experiments on ASDEX have been performed at 67 MHz, corresponding to 2Ωsub(CH)-heating of a hydrogen plasma at B_0=2.2T. Despite divertor operation ICRH is accompanied by a significant increase of impurity production which can drastically be reduced by means of wall carbonisation. RF power up to 2.3 MW is routinely coupled to the plasma for pulse lengths of up to 1 sec. The rf heating is found to depend strongly on plasma preheating. In combination with neutral beam injection the ICRF heating efficiency is even higher than the one of NI. Confinement degrades with ICRH to values in between NI-L-type and OH confinement. (orig.).

35301 (IPP—III/107, pp 69-72) **Lower hybrid heating effects in the ASDEX tokamak.** Eckhartt, D.; Leuterer, F.; Soeldner, F.; Eberhagen, A.; Mertens, V.; Murmann, H.; Becker, G.; Bosch, H.S.; Brambilla, M.; Brocken, H. (Association Euratom-Max-Planck-Institut fuer Plasmaphysik, Garching, Germany, F.R.; Comitato Nazionale per l'Energia Nucleare, Frascati, Italy; CEA Centre d'Etudes Nucleaires de Grenoble, 38, France; Nuclear Development Corp. of South Africa, Pty. Ltd., Pelindaba, Pretoria; Washington Univ., Seattle, USA). Nov 1985. NTIS (US Sales Only), PC A05/MF A01. File Number DE86752047. (CONF-850927—Exc.).

From 12. European conference on controlled fusion and plasma physics; Budapest, Hungary (2 Sep 1985).

During Lower Hybrid experiments in ASDEX significant bulk plasma heating was observed inside regions of the parameter space where none of the quasilinear theories would predict coupling to any of the thermal plasma constituents. Launching of 400 kW of LH power at 1300 Mhz during 1 s in a deuterium plasma, generated by Ohmic heating, produced a maximum increase of the central electron temperature (ΔTsub(e)(0) of about 600 eV at an average plasma density anti nsub(e) = 0,8.10^{13} cm^{-3}, while the maximum ion temperature increase ΔTsub(i)(0) = 150 eV occurred at anti nsub(e) = 3.10^{13} cm^{-3}. These heating effects have been investigated in more detail. (orig./GG).

35302 **(LA-UR—86-1810) Charge and current neutralization physics of a heavy ion beam during final transport.** Magelssen, G.R.; Forslund, D.W. (Los Alamos National Lab., NM (USA)). May 1986. Contract W-7405-ENG-36. 9p. (CONF-860510—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011243.

From Symposium on heavy ion fusion; Washington, DC, USA (27 May 1986).

Heavy ion fusion requires high power to be focussed onto a small pellet. If the reactor chamber pressure is below 10^{-4} to 10^{-5} Torr, beam compression will be limited by space charge unless neutralized by co-moving electrons. If higher chamber pressures are used, the heavy ion beam will create a significant number of background electrons during its propagation and will undergo stripping. The background electrons could provide the neutralization required for high beam intensities. In this paper we will focus on the physics associated with propagation through a fully ionized hydrogen plasma, so background electron generation is not included. One-dimensional electrostatic and two-dimensional fully electromagnetic particle-in-cell simulations are presented. If a background plasma is present, we find that coinjected electrons whose purpose is to charge and current neutralize the ion beam become two-stream unstable and no longer provide the thermally cool neutralization required. Further, we find that the ion induced background electron temperature is very sensitive to the ion beam to background electron charge density ratio.

35303 **(LBL—21223) Neutralization of a fast negative-ion beam.** Schlachter, A.S.; Mowat, J.R.; Stearns, J.W.; Gohil, P.; Pyle, R.V. (Lawrence Berkeley Lab., CA (USA)). Jan 1986. Contract AC03-76SF00098. 14p. (CONF-860148—7). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011315.

From 2. United States/Mexico cooperative symposium on atomic and molecular physics; Cocoyoc, Mexico (1 Jan 1986).

Neutralization of a fast negative-ion beam, primarily H^-, is discussed in terms of competing one- and two-electron detachment processes in a variety of media: gas (vapor), plasma, liquid sheet, solid foil.

35304 **(ORNL/FEDC—85/9) Material options for a commercial fusion reactor first wall.** Dabiri, A.E. (Oak Ridge National Lab., TN (USA)). May 1986. Contract AC05-84OR21400. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86011352.

A study has been conducted to evaluate the potential of various materials for use as first walls in high-power-density commercial fusion reactors. Operating limits for each material were obtained based on a number of criteria, including maximum allowable structural temperatures, critical heat flux, ultimate tensile strength, and design-allowable stress. The results with water as a coolant indicate that a modified alloy similar to HT-9 may be a suitable candidate for low- and medium-power-density reactor first walls with neutron loads of up to 6 MW/m^2. A vanadium or copper alloy must be used for high-power-density reactors. The neutron wall load limit for vanadium alloys is about 14 MW^2, provided a suitable coating material is chosen. The extremely limited data base for radiation effects hinders any quantitative assessment of the limits for copper alloys.

35305 **(ORNL/FEDC—86/2) Economic considerations of commercial tokamak options.** Dabiri, A.E. (Oak Ridge National Lab., TN (USA)). May 1986. Contract AC05-84OR21400. 29p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86011353.

Systems studies have been performed to assess commercial tokamak options. Superconducting, as well as normal, magnet coils in either first or second stability regimes have been considered. A spherical torus (ST), as well as an elongated tokamak (ET), is included in the study. The cost of electricity (COE) is selected as the figure of merit, and beta and first-wall neutron wall loads are selected to represent the physics and technology characteristics of various options. The results indicate that an economical optimum for tokamaks is predicted to require a beta of around 10%, as predicted to be achieved in the second stability regime, and a wall load of about 5 MW/m^2, which is assumed to be optimum technologically. This tokamak is expected to be competitive with fission plants if efficient, noninductive current drive is developed. However, if this regime cannot be attained, all other tokamaks operating in the first stability regime, including spherical torus and elongated tokamak and assuming a limiting wall load of 5 MW/m^2, will compete with one another with a COE of about 50 mill/kWh. This 40% higher than the COE for the optimum reactor in the second stability regime with fast-wave current drive. The above conclusions pertain to a 1200-MW(e) net electric power plant. A comparison was also made between ST, ET, and superconducting magnets in the second stability regime with fast-wave current drive at 600 MW(e).

35306 **(PPPL—2333) Assessment of eddy current effects on compression experiments in the TFTR tokamak.** Wong, K.L.; Park, W. (Princeton Univ., NJ (USA). Plasma Physics Lab.). May 1986. Contract AC02-76CH03073. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011172.

The eddy current induced on the TFTR vacuum vessel during compression experiments is estimated based on a cylindrical model. It produces an error magnetic field that generates magnetic islands at the rational magnetic surfaces. The widths of these islands are calculated and found to have some effect on electron energy confinement. However, resistive MHD simulation results indicate that the island formation process can be slowed down by plasma rotation.

35307 **(PPPL—2341) Application of coincidence techniques to fusion product measurements.** Murphy, T.J.; Heidbrink, W.W.; Strachan, J.D. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jun 1986. Contract AC02-76CH03073. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011362.

Measurement of two products of a fusion reaction in coincidence is proposed. Possible detector arrays and sample count rates have been evaluated for reactions in the TFR and TEXT tokamaks and in the TFTR neutral beamlines. The count rates indicate that this method is feasible on existing devices.

35308 **(PPPL—2345) Environmental monitoring report for calendar year 1985.** Stencel, J.R. (Princeton Univ., NJ (USA). Plasma Physics Lab.). May 1986. Contract AC02-76CH03073. 91p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86011149.

The results of the environmental monitoring program for CY85 for the Princeton Plasma Physics Laboratory (PPPL) are presented and discussed. All of the tokamak machines, the Princeton Large Torus (PLT), Princeton Beta Experiment (PBX), and the Tokamak Fusion Test Reactor (TFTR), has a full year of run time. In addition, the S-1 Spheromak and the RF Test Facility were in operation. The phased approach to TFTR environmental monitoring continued with the establishment of locations for off-site monitoring. An environmental committee established in December 1984 reviewed items of environmental importance. During CY85 no adverse effects to the environmental resulted from any operational program activities at PPPL, and the Laboratory was in compliance with all applicable Federal, State, and local environmental regulations.

35309 **(SAND—85-2585) Computer simulations of the ring diode for Saturn.** Iwan, D.C. (Sandia National Labs., Albuquerque, NM (USA)). May 1986. Contract AC04-76DP00789. 46p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86011546.

Computer simulations were made of the ring diode to be used on the large-area high-dose x-ray simulator - Saturn - which will test radiation effects on systems and subsystems at Sandia National Laboratories. These computer simulations showed that the Saturn diode should be able to meet its design specifications both for peak power and energy deposited (5×10^{12} rad/s in silicon and 5 cal/g in gold over a 500 square centimeter area) and for uniformity of the x-ray source. The computer simulations were also compared with analytic theory to predict scaling of the diode. The Saturn diode impedance was found to scale linearly with axial anode-cathode gap, indicating that pinching will dominate the elec-

tron flow. Analysis of the simulations of the electron flow along the shanks showed that the electron flow tended to be more cycloidal near the cathode, but more laminar near the edge of the flow.

35310 **(SAND—85-2735C) Hydrogen and deuterium in graphite limiters from TFTR, PDX and PLT.** Wampler, W.R.; Doyle, B.L.; Pontau, A.E. (Sandia National Labs., Albuquerque, NM (USA); Sandia National Labs., Livermore, CA (USA)). 1986. Contract AC04-76DP00789. 19p. (CONF-860522—7). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011419.

From 7. international conference on plasma surface interactions in controlled fusion devices; Princeton, NJ, USA (5 May 1986).

Retention of hydrogen isotopes in graphite limiters impacts plasma fueling, isotope changeover rates and tritium inventory in fusion reactors. This paper describes measurements of the amount of euterium (D) in graphite tiles from the TFTR limiter, and in graphite limiters from PDX and PLT, after extended exposure to high power D plasmas. D concentrations decreased abruptly over the first micron and fell to the bulk value of 4 to 13 atomic, ppM beyond 40 microns from the exposed surface. The average near-surface aeral densities of D on the TFTR tiles was 10^{17} D/cm^2. The total amount of near-surface D in TFTR limiters estimated using this value is larger than the amount of D in a plasma but small compared to the allowed tritium inventory. The D concentrations found in the bulk are large enough to be an important factor for tritium inventory. The 1 at. % of hydrogen (H) found in the limiters and in graphite not exposed to plasma may be an important source of hydrogen to the plasma. We discuss the influence of the H and D concentrations found in the bulk of graphite on tritium inventory estimates and hydrogen isotope changeover rates.

35311 **(SAND—85-2736C) Surface-limited release of deuterium from iron.** Wampler, W.R. (Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 17p. (CONF-860522—6). NTIS, PC A02/MF A01; GPO Dep. File Number DE86011420.

From 7. international conference on plasma surface interactions in controlled fusion devices; Princeton, NJ, USA (5 May 1986).

The release of deuterium (D) from solution in iron was measured for conditions approaching a bare-metal surface on single crystal and polycrystalline samples sputter-cleaned in uhv. The release rate was found to be proportional to the square of the concentration of D in solution. The second-order kinetics show the release is limited by molecular recombination of D on the surface. The recombination coefficient (K) measured for clean surfaces can be described by K = K_o exp(Q/sub K//kT) with $K_o = 10^{-31}$ cm^4/s and Q/sub K/ = 0.69 +- 0.06 eV. These recombination coefficients are orders of magnitude larger than those previously reported for iron. A model for K is presented in which the rate limiting step is the recombination and desorption of D chemisorbed on the surface. The magnitude and temperature dependence of K predicted by the model are in good agreement with the measurements for iron. Controlled dosing of the samples with oxygen showed that submonolayer oxygen coverages cause large reductions in the D release rate.

35312 **(SAND—85-2738C) Intense proton beam focusing experiments on PBFA-I.** Maenchen, J.; Ruiz, C.L.; Mehlhorn, T.A.; Woodworth, J.R.; Renk, T.J.; Slutz, S.A.; Sweeney, M.A.; Leeper, R.J.; Stygar, W.A.; Olsen, J.N. (Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 5p. (CONF-860665—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010986.

From 6. international conference on high power particle beams; Kobe, Japan (9 Jun 1986).

Significant improvements have been made recently in the generation and focusing of intense proton beams on the PBFA-I accelerator using a magnetically-insulated ion diode. Ions are accelerated from a 15-cm radius cylindrical flashover anode plasma across a 6.5-mm vacuum gap to a virtual cathode electron cloud contained by a 15-KG vertical field, then travel radially inward toward a common axial focal spot. Numerous conditions must be met simultaneously to achieve a high focal intensity. These include accelerator symmetry, power flow coupling into the diode, prompt generation of the anode plasma, acceleration of the proton component of the anode plasma, beam aiming control and stability, transport, and coupling of the intense proton beam into a central target. We have studied these physical requirements and developed methods of addressing these issues. Successful applications of our improved understanding during the past year have (a) doubled the accelerator power and energy coupled into the diode structure (10 TW and 300 kJ), (b) halved the anode plasma initiation delay, (c) reduced the ion beam space charge divergence, and (d) produced improved proton focal intensities of voltages above 1.5 MV.

35313 **(SAND—86-1083C) Present status and future prospects of light ions as drivers for inertial fusion.** VanDevender, J.P. (Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 10p. (CONF-860510—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011423.

From Symposium on heavy ion fusion; Washington, DC, USA (27 May 1986).

Light ion beams offer a low cost (50 to 80 $/J for repetitive driver), 20% efficient driver for Inertial Confinement Fusion (ICF). Since the ions deposit their energy in a dense (10^{22} electrons/cm^3) plasma and are shielded from each other, collective effects and the associated preheating electrons are avoided. Power concentration has been the dominant problem. In 1984, a proof-of-principle experiment demonstrated an intense ion beam with adequate beam divergence (15 mrad) at the source current and charge density required for fusion. In 1985, the result was scaled to the total current and source dimensions required for ignition, and the Particle Beam Fusion Accelerator II (PBFA II) was completed. PBFA II is designed to generate and focus a lithium ion beam onto a spherical target at 100 TW/cm^2, investigate ignition, and explore the technology required for high gain targets. The principal research topics for the light ion approach have been the generation of a sufficiently powerful electrical pulse, the transformation of that electrical energy into particle beam energy, the focusing of the beam to the few-millimeter diameter, and the transport of the beam to a target at some distance from the source. Substantial progress has been made on all of these areas and the perceived risk of the light ion approach has been substantially reduced.

35314 **(UCID—20228) Flibe/He/Fs/Be concept.** Moir, R. (Lawrence Livermore National Lab., CA (USA)). Oct 1984. Contract W-7405-ENG-48. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010862.

A number of special issues for the Flibe design are described. The salt tubes immersed in the bed of beryllium balls must be spaced so the balls can flow into or out of the tube region with no bridging resulting in flow stoppage. We have conducted flow tests which show that if the balls are no larger in diameter than one-half of the free space between tube walls, free flow will occur. Since some balls may crack or swell and develop imperfections of shape, we prefer that the ball diameter not exceed one-third of that free space. The pebble size is picked to be large enough to avoid excessive pumping power but small enough to freely flow between the tubes during pebble changeout and during periodic pebbles movement to allow for pebble swelling.

35315 **(UCID—20229) Tritium permeation and recovery for the Flibe/He blanket design.** Moir, R. (Lawrence Livermore National Lab., CA (USA)). Oct 1984. Contract W-7405-ENG-48. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010863.

This study assumes tritium to be a gas dissolved in molten salt, with TF formation suppressed. Tritium permeates readily through the hot steel tubes of the reactor and steam generator and will leak into the steam system at the rate of about one gram per day in the absence of special permeation barriers, assuming that 1% of the helium coolant flow rate is processed for tritium recovery at 90% efficiency per pass. Tritiated water in the steam system is a personnel hazard at concentration levels well below one part per million and this level would soon be reached without costly isotopic processing. Alternatively, including a combination of permeation barriers on reactor and steam generator tubes and molten salt processing is estimated to reduce the leak rate into the steam system by over two orders of magnitude. For the option with the lowest estimated leak rate, 55 Ci/d, it may be possible to purge the steam

system continuously to prevent tritiated water buildup. At best, isotopic separation of dilute tritiated water may not be necessary and for higher leak-rate options the isotopic processing rate can be reduced. The proposed permeation barrier for the reactor tubes is a 10 μm layer of tungsten which, in principle, will reduce tritium blanket permeation by a factor of about 300 below the bare-steel rate.

35316 (UCID—20230) Helium cooled Flibe blanket. Moir, R. (Lawrence Livermore National Lab., CA (USA)). Oct 1984. Contract W-7405-ENG-48. 3p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86010859.

The blanket design uses a pressure vessel to contain the 50 atmosphere helium gas. Helium cools the first wall and blanket internals. The internals consist of a bed of beryllium balls nominally 1 cm diameter in which neutrons are multiplied and later captured, breeding adequate (even excess) amounts of tritium and releasing energy in exothermic nuclear reactions. Tritium is bred in the molten flibe salt which flows slowly (0.1m/sec) in steel tubes. The salt is kept reducing by periodic reacting with beryllium so the tritium will be in the T_2 form, however with somewhat enhanced corrosion rate the salt could be kept oxidizing in which case the tritium would be in the TF form. To prevent the tritium from permitting too much into the helium stream, a tungsten coating on the inside of the tubes is proposed. Tritium is removed from the salt and helium by processing both. Because the solubility of tritium in Flibe is so low, there will be a strong driving force for tritium permeation and this places a great burden on a high integrity tungsten permeation barrier. The tritium in the helium is prevented from permeating excessively into the steam system by jacketing the steel steam generator tubes with a 1 mm aluminum jacket. Clearly, tritium containment and barrier development are the most important feasibility issues for this design.

35317 (UCID—20231) Neutronics design. Moir, R. (Lawrence Livermore National Lab., CA (USA)). Oct 1984. Contract W-7405-ENG-48. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010861.

Initial scoping calculations were done by Lee at LLNL with the TART code and ENDL data to determine the tritium breeding potential of this blanket type. A radially zoned cylindrical nucleonics model was used and is described. Results, local (100% blanket coverage) T and M vs Be zone thickness, are shown. The tritium breeding ratio, T, is seen to vary between 0.5 with no Be to 1.7 with a 60-cm Be zone. Correspondingly, energy multiplication, M, varies between 1.1 and 1.4. The effects of less than 100% blanket coverage on T is shown. For example, if the effective coverage is only 80, a 15-cm Be zone is needed for T = 1.01 compared to 10 cm at full coverage. Higher T can be achieved, of course, by increasing the Be zone thickness. Another possibly attractive use of the excess neutrons generated in Be is for higher M. While this was not the objective here it is clearly possible to include material in the blanket with significantly higher Q's than 4.8 MeV for the Li6(n,t) reaction. Also enriching the Li in Li6 can increase T.

35318 (UCID—20232) Activation/waste management. Maninger, C. (Lawrence Livermore National Lab., CA (USA)). Oct 1984. Contract W-7405-ENG-48. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010860.

The selection of materials and the design of the blankets for fusion reactors have significant effects upon the radioactivity generated by neutron activation in the materials. This section considers some aspects of materials selection with respect to waste management. The activation of the materials is key to remote handling requirements for waste, to processing and disposal methods for waste, and to accident severity in waste management operations. In order to realize the desirable evnironmental potentials of fusion power systems, there are at least three major goals for waste management. These are: (a) near-surface burial; (b) disposal on-site of the fusion reactor; (c) acceptable radiation doses at least cost during and after waste management operations.

35319 (UCID—20233) Flibe/Be/He/FS concept (R = 1). Moir, R. (Lawrence Livermore National Lab., CA (USA)). Oct 1984. Contract W-7405-ENG-48. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011009.

The blanket concept is described. Beryllium, in the form of pebbles nominally 1 cm diameter in a 20 cm thick bed, is employed to multiply neutrons. The multiplier zone is followed by a zone of silicon carbide (SiC) which slows neutrons. Neutrons are captured in the Lithium-6 carried in the molten fluoride salt (LiF + BeF- melting point, 363°C) to breed tritium and release extra energy in exothermic nuclear rections. The salt flows slowly through tubes in the blanket and out to a simple flash separator where the tritium is removed. Helium flows radially through the Be pebble bed and SiC region carrying the heat out to the thermal conversion plant. The tubes are coated either on the inside or outside with a 10 μm tungsten barrier by chemical vapor deposition to cut down tritium permeation to the helium coolant circuit. With the tungsten barrier on the inside the tritium inventory in the tube walls is small and tungsten will contribute to corrosion inhibition. A 1-mm aluminum jacket on the steam generator tubes keeps the tritium permeation to the steam down to 30 curies per day. The design can be converted into a fission-suppressed fissile breeder by thickening the beryllium zone by a factor of 2 or so and adding ThF_4 to the salt in which case 6 tonnes of uranium-233 would be produced per year.

35320 (UCLA/PPG—964) Fractional power operation of tokamak reactors: issues and prospects. Mau, T.K.; Vold, E.L.; Conn, R.W. (California Univ., Los Angeles (USA)). Apr 1986. Contract AS03-80ER52061. 51p. NTIS, PC A04/MF A01; GPO Dep. File Number DE86010614.

The capability of a power plant to operate at a wide range of output power is essential for initial commissioning and normal maintenance. In this work, we explore critical physics issues related to operating a tokamak fusion reactor at fractions of its rated power and identify methods for power control. Analysis is carried out with a steady-state, profile-dependent, zero-dimensional power balance model of the plasma in which several empirical transport scalings appropriate to tokamaks are used. It is found that reactor operation depends strongly on the confinement model, plasma β limit, and the effect of alpha power on transport. Parametric calculations indicate that density, auxiliary heating power and an effective external confinement control mechanism are the key control elements, and burn control is required in most cases. Transition between power plateaus is facilitated by operating, in the hybrid transformer mode. In general, the impact of fractional power operation on full power reactor designs appears to be small.

35321 (UCLA/PPG—967) Two-dimensional toroidal geometry neutral atom transport and material erosion rates in the TEXTOR and TFTR tokamaks. Hasan, M.Z.; Conn, R.W. (California Univ., Los Angeles (USA). Dept. of Mechanical, Aerospace and Nuclear Engineering). May 1986. Contract AS03-80ER52062. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010911.

The power deposition and wall material erosion rates due to charge-exchange neutral atoms resulting from a recycling source at limiters in the TEXTOR and TFTR tokamaks are reported. The analysis is carried out using a recently developed finite element, two-dimensional toroidal geometry diffusion theory neutral atom transport theory and the computer code, FENAT. The power deposition and material erosion are highest at the limiter. The first wall suffers very little erosion except for the portion near the limiter.

35322 (UCLA/PPG—968) ALT-I pump limiter experiments with ICRF heating on TEXTOR. Leung, W.K.; Goebel, D.M.; Conn, R.W.; Dippel, K.H.; Finken, K.H.; Thomas, G.J. (California Univ., Los Angeles (USA). Center for Plasma Physics and Fusion Engineering; Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.); Sandia National Labs., Livermore, CA (USA)). May 1986. Contract FG03-85ER51069. 22p. (CONF-860522—4). NTIS, PC A02/MF A01; GPO Dep. File Number DE86010914.

From 7. international conference on plasma surface interactions in controlled fusion devices; Princeton, NJ, USA (5 May 1986).

The ALT-I (Advanced Limiter Test-I) was installed on TEXTOR to benchmark the ability of a pump limiter as an efficient particle collector and to determine the physics of pump limiter operation. Experiments continue to show its capability of removing particles from the plasma edge under different operating conditions.

In this paper we report first experimental results using ALT-I in conjunction with high power ICRF heating. The particle removal rate increases as the edge flux and density increase during the ICRF pulse. For a head geometry that collects flux from both electron and ion drift sides, the plasma temperature rise is asymmetric with electron temperature on the electron side increasing more than on the ion side during the ICRF pulse. When ALT-I is the major limiter, the particle fluxes on both sides increase by about the same factor and the particle flux on the ion side is always larger, by a factor of 1.5 to 2 than on the electron side during both ohmic and ICRF periods. The degradation of particle confinement inferred from Langmuir probe measurement is more than a factor of two at a maximum achieved power of 2 MW.

35323 **(UCRL—15806-Rev.1) Seismic analysis of the Mirror Fusion Test Facility: soil structure interaction analyses of the Axicell vacuum vessel. Revision 1.** Maslenikov, O.R.; Mraz, M.J.; Johnson, J.J. (Structural Mechanics Associates, San Ramon, CA (USA)). Mar 1986. Contract W-7405-ENG-48. 151p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE86010789.

This report documents the seismic analyses performed by SMA for the MFTF-B Axicell vacuum vessel. In the course of this study we performed response spectrum analyses, CLASSI fixed-base analyses, and SSI analyses that included interaction effects between the vessel and vault. The response spectrum analysis served to benchmark certain modeling differences between the LLNL and SMA versions of the vessel model. The fixed-base analysis benchmarked the differences between analysis techniques. The SSI analyses provided our best estimate of vessel response to the postulated seismic excitation for the MFTF-B facility, and included consideration of uncertainties in soil properties by calculating response for a range of soil shear moduli. Our results are presented in this report as tables of comparisons of specific member forces from our analyses and the analyses performed by LLNL. Also presented are tables of maximum accelerations and relative displacements and plots of response spectra at various selected locations.

35324 **(UCRL—53697) Condensation of ablated first-wall materials in the cascade inertial confinement fusion reactor.** Ladd, A.J.C. (Lawrence Livermore National Lab., CA (USA)). 18 Dec 1985. Contract W-7405-ENG-48. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011366.

This report concerns problems involved in recondensing first-wall materials vaporized by x rays and pellet debris in the Cascade inertial confinement fusion reactor. It examines three proposed first-wall materials, beryllium oxide (BeO), silicon carbide (SiO), and pyrolytic graphite (C), paying particular attention to the chemical equilibrium and kinetics of the vaporized gases. The major results of this study are as follows. Ceramic materials composed of diatomic molecules, such as BeO and SiC, exist as highly dissociated species after vaporization. The low gas density precludes significant recombination during times of interest (i.e., less than 0.1 s). The dissociated species (Be, O, Si, and C) are, except for carbon, quite volatile and are thermodynamically stable as a vapor under the high temperature and low density found in Cascade. These materials are thus unsuitable as first-wall materials. This difficulty is avoided with pyrolytic graphite. Since the condensation coefficient of monatomic carbon vapor ($\sim$ 0.5) is greater than that of the polyatomic vapor ($<$0.1), recondensation is assisted by the expected high degree of dissociation. The proposed 10-layer granular carbon bed is sufficient to condense all the carbon vapor before it penetrates to the BeO layer below. The effective condensation coefficient of the porous bed is about 50% greater than that of a smooth wall. An estimate of the mass flux leaving the chamber results in a condensation time for a carbon first wall of about 30 to 50 ms. An experiment to investigate condensation in a Cascade-like chamber is proposed.

35325 **(UCRL—94321) Progress in the ICF Program at the Lawrence Livermore National Laboratory.** Hogan, W.J. (Lawrence Livermore National Lab., CA (USA)). 20 May 1986. Contract W-7405-ENG-48. 21p. (CONF-860551—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010945.

From Technical meeting and workshop on fusion reactor design a. ' technology; Yalta, USSR (26 May 1986).

Experiments using the harmonically converted Nd:glass lasers at the Lawrence Livermore National Laboratory (Novette with 2 to 10 kJ at 0.26 and 0.53 micron and Nova with 30 to 80 kJ at 0.35 and 0.53 micron) have demonstrated favorable coupling of laser light to fusion targets. The coupling of short-wavelength laser light to these plasmas is now well understood and is primarily collisional in nature, in contrast to previous experiments at 1.06 microns and 10 microns, where the coupling was collective. Increased absorption and conversion to x-rays and decreased production of suprathermal electrons was measured with decreasing wavelength. Stimulated Raman scattering was identified as the primary source of the suprathermal electrons. The collisionality of the laser target coupling can be controlled by the proper selection of laser wavelength and target material. The coupling improvements led directly to the demonstration of higher-density ablative implosions of DT fusion fuel. Experiments on Novette demonstrated a better than 100-fold compression of the DT fuel with two-sided illumination. The Nova laser is extending laser-plasma studies to plasmas several times larger than those used on Novette. Recent experiments have produced a yield of over 10^{13} neutrons. Temporally shaped pulses on Nova will be used to compress DT fuel close to the 200 g/cm^3 densities ultimately required for high-gain target performance.

35326 **(UCRL—94322) Suppressed-fission ICF hybrid reactor.** Hogan, W.J.; Meier, W.R. (Lawrence Livermore National Lab., CA (USA)). 20 May 1986. Contract W-7405-ENG-48. 23p. (CONF-860551—6). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010946.

From Technical meeting and workshop on fusion reactor design and technology; Yalta, USSR (26 May 1986).

A suppressed-fission ICF hybrid reactor has been designed to maximize the production of ^{233}U. In this design, Be is used as a neutron multiplier. An annular array of Be columns surrounds the fusion pulse inside the reaction chember. The Be columns consist of short cylinders of Be joined together with steel snap rings. Vertical holes in the Be carry liquid lithium coolant and steel-clad thorium fuel pins. The lithium coolant is supplied at the top of the chamber, traverses through the Be columns and exits at the bottom. The columns are attached to top and bottom plates in such a way as to tolerate radiation-induced swelling and the vibrations resulting from each fusion pulse. A thin (10 cm) liquid Li fall region protects the Be columns from direct exposure to the X-rays and debris emitted by the fuel capsule. A neutronics study of this design indicates that the specific production of ^{233}U fuel is increased by operating at relatively large thorium volume fractions. A design at a fertile fuel fraction of 30 vol % produces a total breeding ratio of over 2.1. The ^{6}Li to ^{7}Li ratio is adjusted to keep the tritium breeding ratio at about 1.0. In such a reactor, about 3400 kg of ^{233}U can be produced per full power year at a fusion power level of 800 MW. Reactor support ratios greater than 13 can be achieved, leading to beneficial results even if the fusion reactor cost is significantly greater than that of a fission reactor.

35327 **(UCRL—94323) Cascade ICF power reactor.** Hogan, W.J.; Pitts, J.H. (Lawrence Livermore National Lab., CA (USA)). 20 May 1986. Contract W-7405-ENG-48. 17p. (CONF-860551—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010947.

From Technical meeting and workshop on fusion reactor design and technology; Yalta, USSR (26 May 1986).

The double-cone-shaped Cascade reaction chamber rotates at 50 rpm to keep a blanket of ceramic granules in place against the wall as they slide from the poles to the exit slots at the equator. The 1 m-thick blanket consists of layers of carbon, beryllium oxide, and lithium aluminate granules about 1 mm in diameter. The x rays and debris are stopped in the carbon granules; the neutrons are multiplied and moderated in the BeO and breed tritium in the $LiAlO_2$. The chamber wall is made up of SiO tiles held in compression by a network of composite SiC/Al tendons. Cascade operates at a 5 Hz pulse rate with 300 MJ in each pulse. The temperature in the blanket reaches 1600 K on the inner surface and 1350 K at the outer edge. The granules are automatically thrown into three separate vacuum heat exchangers where they give up their energy to high pressure helium. The helium is used in a Brayton cycle to

obtain a thermal-to-electric conversion efficiency of 55%. Studies have been done on neutron activation, debris recovery, vaporization and recondensation of blanket material, tritium control and recovery, fire safety, and cost. These studies indicate that Cascade appears to be a promising ICF reactor candidate from all standpoints. At the 1000 MWe size, electricity could be made for about the same cost as in a future fission reactor.

35328 **Numerical model for swirl flow cooling in high-heat-flux particle beam targets and the design of a swirl-flow-based plasma limiter.** Milora, S.L.; Combs, S.K.; Foster, C.A. (Oak Ridge National Lab., TN, USA). *Nuclear Engineering and Design/Fusion;* 3: No. 3, 301-308(Apr 1986). Contract AC05-84OR21400.

An unsteady, two-dimensional heat conduction code has been used to study the performance of swirl-flow-based neutral particle beam targets. The model includes the effects of two-phase heat transfer and asymmetric heating of tubular elements. The calorimeter installed in the Medium Energy Test Facility, which has been subjected to 30-s neutral beam pulses with incident heat flux intensities of $>=5kW/cm^2$, has been modeled. The numerical results indicate that local heat fluxes in excess of 7 kW/cm^2 occur at the water-cooled surface on the side exposed to the beam. This exceeds critical heat flux limits for uniformly heated tubes with straight flow by approximately a factor of 5. The design of a plasma limiter based on swirl flow heat transfer is presented. (orig.).

35329 **The need for novel neutron energy conversion schemes for DT fusion reactors.** Perkins, L.J.; Logan, B.G.; Henning, C.D. (Lawrence Livermore National Lab., Livermore, CA). pp 672 of Proceedings of condensed papers of the 7th Miami international conference on alternative energy source. Veziroglu, T.N. Coral Gables, FL; Clean Energy Research Institute (1986). (CONF-851201—).

From 7. Miami international conference on alternative energy sources; Miami Beach, FL, USA (9 Dec 1985).

While it is universally accepted that the DT reaction will provide the easiest method of attaining the first generation of fusion power reactors, current conceptual designs indicate that such reactors may be 1.5-2 times as expensive as an equivalent fission plant. Since the fusion nuclear island is inherently more expensive than a fission nuclear island, coupling to a conventional steam cycle balance-of-plant can only lead to a more expensive total. Accordingly, in this paper, the authors explore methods of converting 14 MeV neutron energy to electricity without employing a complex and expensive steam cycle. They show that there is a natural division in these alternative methods into schemes which are Carnot-limited (i.e., produce electricity via an intermediate heat stage) and schemes which intercept the energy flow from neutron-induced charged particles before they slow down and cause bulk heating of the absorbing medium. Furthermore, several of the prospective methods are shown to be fusion-reactor-specific, i.e., they exploit the unique properties of DT fusion and are only applicable to such reactors. In particular, they examine two innovative fusion-specific neutron conversion schemes, namely, (a) radiation-catalyzed MHD conversion which employs the existing reactor magnetic field for in-situ MHD electricity generation, and (b) excimer-channeled UV conversion which converts neutrons to electricity through intermediate UV production via an energy-channeling excimer medium. With these novel methods, the higher cost of a fusion nuclear island over that for fission could be offset by a lower "balance-of-plant" cost, resulting in a power source with attractive economics and enhanced environmental and safety advantages.

35330 **Furnace assembly.** Panayotou, N.F.; Green, D.R.; Price, L.S. (to Dept. of Energy, Washington, DC). US Patent 4,562,037. 31 Dec 1985. Filed date 24 Feb 1983. vp.

PAT-APPL-469606.

A method of and apparatus for heating test specimens to desired elevated temperatures for irradiation by a high energy neutron source. A furnace assembly is provided for heating two separate groups of specimens to substantially different, elevated, isothermal temperatures in a high vacuum environment while positioning the two specimen groups symmetrically at equivalent neutron irradiating positions.

35331 **Three chamber negative ion source.** Leung, K.N.; Ehlers, K.W.; Hiskes, J.R.R. (to Dept. of Energy, Washington, DC). US Patent 4,559,477. 17 Dec 1985. Filed date 10 Nov 1983. vp.

PAT-APPL-550701.

A negative ion vessel is divided into an excitation chamber, a negative ionization chamber and an extraction chamber by two magnetic filters. Input means introduces neutral molecules into a first chamber where a first electron discharge means vibrationally excites the molecules which migrate to a second chamber. In the second chamber a second electron discharge means ionizes the molecules, producing negative ions which are extracted into or by a third chamber. A first magnetic filter prevents high energy electrons from entering the negative ionization chamber from the excitation chamber. A second magnetic filter prevents high energy electrons from entering the extraction chamber from the negative ionizing chamber. An extraction grid at the end of the negative ion vessel attracts negative ions into the third chamber and accelerates them. Another grid, located adjacent to the extraction grid, carries a small positive voltage in order to inhibit positive ions from migrating into the extraction chamber and contour the plasma potential. Additional electrons can be suppressed from the output flux using ExB forces provided by magnetic field means and the extractor grid electric potential.

35332 **Method of forming a continuous polymeric skin on a cellular foam material.** Duchane, D.V.; Barthell, B.L. (to Dept. of Energy, Washington, DC). US Patent 4,555,313. 26 Nov 1985. Filed date 21 Oct 1982. vp.

PAT-APPL-435796.

Hydrophobic cellular material is coated with a thin hydrophilic polymer skin which stretches tightly over the outer surface of the foam but which does not fill the cells of the foam, thus resulting in a polymer-coated foam structure having a smoothness which was not possible in the prior art. In particular, when the hydrophobic cellular material is a specially chosen hydrophobic polymer foam and is formed into arbitrarily chosen shapes prior to the coating with hydrophilic polymer, inertial confinement fusion (ICF) targets of arbitrary shapes can be produced by subsequently coating the shapes with metal or with any other suitable material. New articles of manufacture are produced, including improved ICF targets, improved integrated circuits, and improved solar reflectors and solar collectors. In the coating method, the cell size of the hydrophobic cellular material, the viscosity of the polymer solution used to coat, and the surface tensin of the polymer solution used to coat are all very important to the coating.

35333 **Tungsten-based composite materials for fusion reactor shields.** Greenspan, E.; Karni, Y. (Nuclear Research Center-Negev, Beer Sheva, Israel). *Transactions of the American Nuclear Society;* 50: 440-441(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

Composite tungsten-based materials were recently proposed for the heavy constituent of compact fusion reactor shields. These composite materials will enable the incorporation of tungsten - the most efficient nonfissionable inelastic scattering (as well as good neutron absorbing and very good photon attenuating) material - in the shield in a relatively cheap way and without introducing voids (so as to enable minimizing the shield thickness). It is proposed that these goals be achieved by bonding tungsten powder, which is significantly cheaper than high-density tungsten, with a material having the following properties: good shielding ability and relatively low cost and ease of fabrication. The purpose of this work is to study the effectiveness of the composite materials as a function of their composition, and to estimate the economic benefit that might be gained by the use of these materials. Two materials are being considered for the binder: copper, second to tungsten in its shielding ability, and iron (or stainless steel), the common fusion reactor shield heavy constituent.

35334 Borides versus hydrides for minimizing fusion reactor shield thickness. Kinrot, A.; Greenspan, E. (Nuclear Research Center-Negev, Beer Sheva, Israel). *Transactions of the American Nuclear Society;* **50**: 441-442(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

While searching for designs that could minimize the thickness of the inboard shield of compact tokamaks, El-Guebaly et al. recently concluded that hydrides are (more) effective in minimizing the fast neutron fluence, while borides are superior in reducing the nuclear heating. This conclusion appears to be in contradiction with the authors' finding that when properly combined, tungsten and TiH_2 make the most effective shield for reducing both the heating and the displacement (which is closely related to fast neutron fluence) rates. The purpose of the present work is to explore the above discrepancy.

35336 Fusion neutron streaming in shield gaps. Urban, W.T.; Dudziak, D.J. (Los Alamos National Lab., NM). *Transactions of the American Nuclear Society;* **50**: 453-454(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

Any advance from conceptual to construction design of fusion reactors will require that shield irregularities be dealt with in detail. A rigorous analysis of neutron streaming through shield gaps could easily require unacceptably time-consuming three-dimensional transport calculations. Thus, there is a strong motivation to use approximate techniques in the iterative stages of the design procedure and to use transport calculations only at the final stage of the design if at all. Current analyses of fission reactor shielding gaps and penetrations rely not only on transport calculations but also on a wide variety of semi-analytic approximate formulas, which have been developed over the years on the basis of parametric studies and experimental data. The authors have developed similar approximate formulas for various fusion reactor shield gap configurations based on the results of three-dimensional neutron transport calculations. This work incorporates and extends their previous efforts.

35336 Time-saving methods in fusion shielding analysis. Engholm, B.A.; Su, S.D. (GA Technologies, San Diego, CA). *Transactions of the American Nuclear Society;* **50**: 454-457(Nov 1985). (CONF-851115—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (10 Nov 1985).

GA Technologies has for many years been engaged in the design of fusion reactor systems for US Department of Energy, Electric Power Research Institute, and internally funded programs. Neutronics analysis (transport calculations, shield design, and blanket design) is usually an important sub-task in such a program. It is natural, therefore, that faster, more efficient, and cheaper methods have been sought and developed for performing the shielding analysis and design for these reactors. This paper reviews some of the time-saving methods currently in use at GA. These methods include: 1) point kernel method applied to neutrons; 2) one-dimensional transport code modified to provide shutdown dose rates; 3) one-dimensional substitutes for two-dimensional analysis; 4) surface source version of Monte Carlo code; and 5) Monte Carlo surface source applied to one-dimensional calculations. By applying these short cuts, the authors have been able to complete neutronics analysis subtasks required for reactor design studies that would have otherwise been prohibitively difficult or time consuming.

35337 Laser target fabrication, structure and method for its fabrication. Farnum, E.H.; Fries, R.J. (to Dept. of Energy, Washington, DC). US Patent 4,544,520. 1 Oct 1985. Filed date 25 Jul 1978. vp.

PAT-APPL-928027.

The disclosure is directed to a laser target structure and its method of fabrication. The target structure comprises a target plate containing an orifice across which a pair of crosshairs are affixed. A microsphere is affixed to the crosshairs and enclosed by at least one hollow shell comprising two hemispheres attached together and to the crosshairs so that the microsphere is juxtapositioned at the center of the shell.

35338 Initial results from the ZT-P experiment. Schoenberg, K.F.; Burkhardt, L.C.; Haberstich, A.; Melton, J.G.; Reass, W.; Weber, P.G.; Wurden, G.A. (Los Alamos National Lab., Los Alamos, NM). pp 2P-12 of IEEE conference record-abstracts of the 1985 IEEE international conference on plasma science. Piscataway, NJ; IEEE Service Center (1985). (CONF-850699—).

From Conference on plasma sciences; Pittsburgh, PA, USA (3 Jun 1985).

The ZT-P experiment, with a major radius of 0.45 m and a minor radius of 0.07 m, was designed to prototype the next generation of reversed field pinch machines at Los Alamos. ZT-P utilizes an air-core poloidal field system, with precisely wound and positioned rigid copper coils, to drive the plasma current and provide plasma equilibrium with intrinsically low magnetic field errors. ZT-P also incorporates a modular design to facilitate assembly and disassembly and allow for rapid replacement of various liner/shell assemblies. The primary mission of ZT-P is to aid in the engineering design of future high current RFP devices and to complement the RFP physics research presently under investigation on ZT-40M. ZT-P will provide a test bed for many engineering aspects of large air-core machine design. These include, but are not limited to, plasma formation and equilibrium control with an air-core system, performance and reliability of the air-core poloidal and toroidal field circuit design, data acquisition and experimental control in the presence of high ambient magnetic fields and transient voltages.

35339 Numerical simulation and experimental verification of the IMS modular divertors. Doerner, R.P.; Anderson, D.T.; Anderson, F.S.B.; Probert, P.H.; Talmadge, J.N.; Shohet, J.L. (Torsatron/Stellarator Lab., Univ. of Wisconsin-Madison, Madison, WI). pp 2P-9 of IEEE conference record-abstracts of the 1985 IEEE international conference on plasma science. Piscataway, NJ; IEEE Service Center (1985). (CONF-850699—). Contract AC02-84ER53166.

From Conference on plasma sciences; Pittsburgh, PA, USA (3 Jun 1985).

One of the advantages of the stellarator for plasma magnetic confinement lies in its naturally occurring divertor structure. Modularization of the divertor structure is attractive in a fusion environment in terms of device maintainability and ease of impurity control and refueling. Experiments performed on the Interchangeable Module Stellarator (IMS) confirm the existence of "modular" divertors predicted by a magnetic field line following code. Two-dimensional ion and electron saturation current profiles indicate a particle flux bundle width which is about a factor of two larger than the width of the predicted field line bundles. Electron temperature and density in the divertor region are about 6 eV and 5×10^{10} cm^{-3} as compared to central plasma electron parameters of $\approx$ 15 eV and 3×10^{11} cm^{-3}. The field lines which focus into each of the modular divertor footprints have been found to originate from localized regions of the launch surface outside the separatrix. It has also been found that the modulation of the magnetic field lines in IMS outside the separatrix going into the divertors has similar ripple structure as that just inside the confinement region. Experiments have also been performed while biasing particle collection plates in the divertor regions. Density-decay time increases, and ion saturation current increases have been observed in the central plasma as a result of the bias to these particle collection plates. Electric field measurements in the central plasma, using an emissive probe, are currently being conducted to gain insight into the mechanisms responsible for the changes observed when biases are applied to the divertor shields.

35340 Futher developments in plasma compression opening switch techniques. Goforth, J.H. (Los Alamos National Lab., Univ. of California, Los Alamos, NM). pp 5C-6 of IEEE conference record-abstracts of the 1985 IEEE international conference on plasma science. Piscataway, NJ; IEEE Service Center (1985). (CONF-850699—).

From Conference on plasma sciences; Pittsburgh, PA, USA (3 Jun 1985).

The authors reported earlier on results from planar plasma compression opening switch experiments in which resistance increases of 20 to 40 were achieved in $\approx$400 ns. Further experiemnts have verified resistance scaling laws in the linear current density

range from 0.1 to 0.15 MA/cm. The plasma compression is performed in an annular plasma cavity defined by the radial distance between inner and outer electrodes, l, and the circumference of the annulus at a point equidistant from the electrodes, C. The peak resistance at compression time is found to be roughly proportional to l/C for plasma cavities of the same depth. Small scale experiments in which instabilities have been introduced to the compression wave are also described. Some resistance increases have been achieved above values obtained using completely planar compression, but at the expense of a slower rate of resistance increase. It is common in opening switch work to discuss the rate of resistance rise as an opening switch parameter. However, as regards current transfer experiments, the pulse risetime in a load is determined not only by the rate of resistance rise, but also by the value of the switch resistance and inductance, and the inductances of the load and inductive store. Implications of these considerations to fast pulse delivery in inductive storage circuits using plasma compression techniques are discussed.

35341 **Study of opening switch characteristics of a plasma focus.** Rnee, M.J.; Schneider, R.F. (Lab. for Plasma and Fusion Energy Studies, Univ. of Maryland, College Park, MD). pp 5A-8 of IEEE conference record-abstracts of the 1985 IEEE international conference on plasma science. Piscataway, NJ; IEEE Service Center (1985). (CONF-850699—).

From Conference on plasma sciences; Pittsburgh, PA, USA (3 Jun 1985).

It is shown that a current charged transmission line and an opening switch can be used as an inductive energy storage system to produce a high power pulse. A plasma focus device, in which a transmission line is inserted in series with the capacitor bank and a coaxial gun, is considered as an inductive energy storage system. The m = 0 instability in the plasma focus is utilized as an opening switch and the disrupted plasma column is considered as bipolar diode. The system is described preferably by the transmission line theory rather than the lumped circuit theory. The relationship between the output voltage and the current drop is given by V = ΔIZ, where Z is the characteristic impedance of the transmission line. The current drop ΔI depends on the mismatched load impenance of the plasma diode which is governed by nature of the m = 0 instability. Experimental investigation of opening switch behavior of the m = 0 instability is described.

35342 **Demonstration of a soft X-ray amplifier.** Trebes, J.E. (Lawrence Livermore National Laboratory, University of California, Livermore, CA). pp 3B-1 of IEEE conference record-abstracts of the 1985 IEEE international conference on plasma science. Piscataway, NJ; IEEE Service Center (1985). (CONF-850699—). Contract W-7405-ENG-48.

From Conference on plasma sciences; Pittsburgh, PA, USA (3 Jun 1985).

Soft x-ray amplified spontaneous emission has been observed from exploding foil targets irradiated at the Novette laser facility of the Lawrence Livermore National Laboratory. Thin foils of selenium were irradiated at intensities of 5 x 10^{13} watts/cm^2 producing plasma conditions suitable for population inversions on the $2p^53p$-$2p^63s$ transitions in the neon-like Se ion. Using three independent types of time-resolved, high resolution spectroscopic diagnostics, substantial amplification with gain-length products up to 6 were demonstrated. Gain coefficients of 5.5 +- 1.0 cm^{-1} on the J=2 to 1 transitions at 206.3 and 209.6 A were obtained. No emission was observed on the J=0 to 1 transition which had the highest predicted gain. Scaling to higher Z was accomplished with yttrium. Amplification was observed on the J=2 to 1 lines at 154.9 and 157.1 A.

35343 **Self-similar compression of a magnetized plasma filled liner.** Felber, F.S.; Liberman, M.A.; Velikovich, A.L. (Jaycor, P.O. Box 85154, San Diego, CA). pp 5R-2 of IEEE conference record-abstracts of the 1985 IEEE international conference on plasma science. Piscataway, NJ; IEEE Service Center (1985). (CONF-850699—). Contract FG03-84ER13302.

From Conference on plasma sciences; Pittsburgh, PA, USA (3 Jun 1985).

New analytic, one-dimensional, self-similar solutions of magnetohydrodynamic equations describing the compression of a magnetized plasma by a thin cylindrical liner are presented. The solutions include several features that have not been included in an earlier self-similar solution of the equations of ideal magnetohydrodynamics. These features are the effects of finite plasma electrical conductivity, induction heating, thermal conductivity and related thermogalvanomagnetic effects, plasma turbulence, and plasma boundary effects. These solutions have been motivated by recent suggestions for production of ultrahigh magnetic fields by new methods. The methods involve radially imploding plasmas in which axial magnetic fields have been entrained. These methods may be capable of producing controlled magnetic fields up to ≈ 100 MG. Specific methods of implosion suggested were by ablative radial acceleration of a liner by a laser and by a gas-puff Z pinch. The model presented here addresses the first of these methods. The solutions derived here are used to estimate magnetic flux losses out of the compression volume, and to indicate conditions under which an impulsively-accelerated, plasma-filled liner may compress an axial magnetic field to large magnitude.

35344 **Neon source optimization on double EAGLE.** Rodenburg, R.; Koppel, L.; Burr, L.; Wong, S. (Physics International, 2700 Merced St., San Leandro, CA). pp 5R-4 of IEEE conference record-abstracts of the 1985 IEEE international conference on plasma science. Piscataway, NJ; IEEE Service Center (1985). (CONF-850699—).

From Conference on plasma sciences; Pittsburgh, PA, USA (3 Jun 1985).

The authors present recent results of an experiment at Physics International to optimize a neon gas-puff source on Double-EAGLE, using a series of Mach-8 nozzles of varying diameters. Data to be discussed include relative yields, source spectra, time history of x-ray output and mean photon energies, all as functions of gas pressure, nozzle diameter and Marx charge voltage. Comparison to scaling laws are also included.

35345 **SIRIUS-M, a uniform, illumination direct drive short wavelength laser fusion materials test facility.** Badger, B.; Abdel-Khalik, S.; Attaya, H.; Engelstad, R.; Kulcinski, G.; Lovell, E.; Moses, G.; Peterson, R.; Sawan, M.; Sviatoslavsky, I.; Wittenberg, L. (Univ. of Wisconsin, Madison, WI). pp 4R-11 of IEEE conference record-abstracts of the 1985 IEEE international conference on plasma science. Piscataway, NJ; IEEE Service Center (1985). (CONF-850699—).

From Conference on plasma sciences; Pittsburgh, PA, USA (3 Jun 1985).

The design for a nontritium breeding nonpower producing short wavelength laser fusion materials test facility utilizing direct drive targets and uniform illumination is presented . A target yield of ≈15 MJ and a repetition rate of 10 Hz provides a fusion power of 150 MW. The 4 meter diameter spherical target chamber allows 46 m^2 of wall surface to experience 1 MW/m^2 wall loading over 1 year of operation at 5% duty factor. The wall is protected from the target x-rays and ion debris by 1 torr of xenon gas. Radiation hydrodynamics calculations and transient heat conduction calculations of the wall response show that the design goal of less than 1 mm/year of erosion from the graphite first wall is easily achieved. Design of the materials test modules to maximize damage will be presented. This design involves embedding the test module in a Pb reflector behind the first wall. Such a facility could be used to test ICF reactor materials using a relatively small extrapolation of technology beyond the short wavelength laser based single pulse target development facility used to test high yield targets.

35346 **Blanket materials for fusion reactors.** Johnson, C.E.; Fischer, A.K.; Tetenbaum, M. (Argonne National Lab., IL). pp 166 of IUPAC conference on chemical thermodynamics. Hamilton, Ontario; McMaster University (1984). (CONF-840807—).

From Conference on chemical thermodynamics and 39. calorimetry conference; Hamilton, Canada (13 Aug 1984).

The element lithium, in some form, appears to be the only material suitable for breeding tritium in a fusion reactor. Of the relatively large number of potential breeder forms, three types offer the greatest promise. These include liquid lithium, lithium alloys such as Li_7Pb_2, and the lithium ceramics Li_2O, $LiAlO_2$, Li_4SiO_4,

and Li_2ZrO_3. Other compounds have been proposed but those listed are the most favored of each type. The compound selected as a breeder blanket material must satisfy many requirements. It must possess desirable neutronic and irradiation characteristics, exhibit chemical stability at high temperatures, be compatible with other blanket and structural materials, and must breed and release tritium. The properties of the ceramic materials that make them potentially useful have been surveyed. Results from these studies will be presented and related to the temperature range of utility in a breeder, thermal conductivity, oxygen potential, and the expected HT/HTO balance in the system, and the solubility of hydroxide/tritoxide.

35347 **Heat transfer and mechanical interactions in fusion nuclear systems.** Nygren, R.E. (Fusion Power Program, Argonne National Lab., Argonne, IL 60439). pp 11 of Proceedings of the ASME winter annual meeting. New York, NY; American Society of Mechanical Engineers (1984). (CONF-841201—).

From ASME winter annual meeting; New Orleans, LA, USA (9 Dec 1984).

This general review of design issues in heat transfer and mechanical interactions of the first wall, blanket and shield systems of tokamak and mirror fusion reactors begins with a brief introduction to fusion nuclear systems. The design issues are summarized in tables and the following examples are described to illustrate these concerns: the surface heating of limiters, heat transfer from solid breeders, MHD effects in liquid metal blankets, mechanical loads from electromagnetic transients and remote maintenance.

35348 **Thermal design considerations for the first wall and limiter for the Riggatron fusion power core.** Vrable, D.L.; Ginsburg, C.W. (INESCO, La Jolla, CA). pp 9 of Proceedings of the ASME winter annual meeting. New York, NY; American Society of Mechanical Engineers (1984). (CONF-841201—).

From ASME winter annual meeting; New Orleans, LA, USA (9 Dec 1984).

The Riggatron Fusion Power Core (FPC) concept makes use of a compact, high-field tokamak with water-cooled, normal-conducting magnets. The high magnetic field allows an increased plasma density and results in a large fusion power output from a small volume. The high power density, however, imposes severe thermal loading on the components and structures that immediately surround the plasma. These components are the first wall (FW) vessel and limiter. The functions of the FW and limiter are to provide thermal protection for the magnetic coils, provide a primary vacuum boundary, maintain acceptable plasma impurity influx and aid in plasma control and stability. The FW and limiter thermal loading is comprised of incident surface flux and volumetric heating components. The magnitude of the thermal loads is far above those anticipated in other fusion devices. Surface fluxes in the range of 1-20 MW/m^2 coupled with volumetric heating densities of 50-100 MW/m^3 impose very stringent thermal design requirements. This paper describes the thermal loading on the FW and limiter structures and discusses the heat transfer mechanisms and thermal tradeoffs in the design of these high thermal performance components.

99 GENERAL AND MISCELLANEOUS

35349 **(DOE/IG—0008/10-1) Office of Inspector General semiannual report to the Congress, October 1, 1985-March 31, 1986.** (USDOE Office of Inspector General, Washington, DC). May 1986. 35p. TIC, PO Bx 62, Oak Ridge, TN 37831. File Number TI86011002.

Two hundred twenty-nine reports were issued. The total consists of 145 contract and 84 internal audit reports. Total number of reports represents an 80% increase over the last reporting period. In addition, the number of reports issued was over 200% higher than issued during the same period last year. Twenty investigations were referred to the Department of Justice for prosecution. Two indictments and three convictions were obtained. Another 10 investigations resulted in disciplinary actions of either DOE or contractor employees. Forty-eight investigations were opened during the period and 45 were closed, leaving an ending inventory of 309.

35350 **(LBL-PUB—445) Lawrence Berkeley Laboratory recent papers submitted and reports issued, February 1986.** (Lawrence Berkeley Lab., CA (USA)). Feb 1986. Contract AC03-76SF00098. 17p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86011319.

132 references are arranged under the following headings: accelerator and fusion research, applied science, biology and medicine, Center for Advanced Materials, chemical biodynamics, earth sciences, engineering, materials and molecular research, nuclear science, and physics. (DLC)

9901 Management

35351 **(AD-A—163640/6/XAB) US Army test and evaluation command, test operations procedure. Cold Regions environmental test of nuclear, biological, and chemical equipment (alarms and detectors). Final report.** (Army Test and Evaluation Command, Aberdeen Proving Ground, MD (USA)). 8 Jan 1986. 39p. (TOP—8-4-005). NTIS, PC A03/MF A01.

This TOP prescribes methods for evaluating the nuclear, biological and chemical (NBC) alarms and detectors in the natural cold regions environment. It contains procedures for evaluating storage, transportation, environmental performance, logistic supportability, reliability, human factors, and safety. It describes the necessary facilities and instrumentation requirements for test accomplishment.

35352 **(ANL/TM—440) Overview of the non-programmatic cost projection prototype.** Keto, D.N. (Argonne National Lab., IL (USA)). Apr 1986. Contract W-31-109-ENG-38. 57p. NTIS, PC A04/MF A01; GPO Dep. File Number DE86010965.

CostPro is a locally-developed computerized system that provides uniform planning and tracking tools for the Argonne National Laboratory. CostPro is designed to accomplish the following tasks: simplified storing of large amounts of data, high speed processing for reports, and easy interfacing to other laboratory business systems. CostPro also has the capability to transfer data among a number of personal computer-based software products. Background information on the Non-Programmatic Cost Projection System is provided. Budgeting and tracking requirements of the Laboratory's Budget Office, how the Cost Projection System meets those requirements, the additional requirements defined by the Computerized Non-Programmatic Planning Model Working Group, and how the Cost Projection System satisfies those additional requirements are described. The concepts and functions of the Cost Projection System are explained. Examples are provided of how to use the Cost Projection System to prepare the data and documents for a fiscal year budget, track actual cost against the budget and revise the fiscal year budget during the year. After reading this document, readers should understand what the Non-Programmatic Cost Projection System can do to help them in their work.8 figs.

35353 **(DOE/MA—0221) Cost and Schedule Control Systems Criteria for contract performance measurement. Data Analysis Guide.** (USDOE Assistant Secretary for Management and Administration, Washington, DC. Office of Project and Facilities Management). Mar 1986. 128p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE86010796.

The Data Analysis Guide has been prepared to aid both DOE and industry personnel in the effective use of contract performance measurement data. It suggests techniques for analyzing contractor cost and schedule data to give insight into current contract performance status and help validate contractor estimates of future contract performance. The techniques contained herein should be modified and tailored to fit particular project and special needs.

35354 **(DOE/MA—0223) Equal Employment Opportunity affirmative action program plan.** Zane, C.K. (USDOE Assistant Secretary for Management and Administration, Washington, DC. Office of Equal Opportunity). 1986. 36p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86010855.

Included are: tables on changes in work force, distribution of EEO groups, hiring goal accomplishments, barrier elimination reports, hiring goals, and internal movement goals.

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REFER ALSO TO CITATION(S) 34186, 34264, 34505, 35176, 35246, 35280, 35352

35355 **(AD-A—163865/9/XAB) Man-machine systems of the 1990 decade: cognitive factors and human interface issues. Technical report.** Hoffman, P.J. (Naval Postgraduate School, Monterey, CA (USA)). Aug 1985. 53p. (NPS—74-85-002). NTIS, PC A04/MF A01.

The primary psychological concepts fundamental to the design of man-machine interfaces for intelligent systems of the 1990's are presented. These concepts embrace perception, learning motivation, and cognitive capacities of human operators, in systems that require a high degree of operator-machine interaction. The central role of feedback is emphasized through simple schematic examples, designed to provide an understanding of the reciprocity requirements in man-machine communication. Cognitive theory and recent experimental data form the basis for discussion of visual image storage, short-term memory, long-term memory, transfer rates and buffering of information being processed by the human operator, under control of a central processor with a cycle time of roughly 70 milliseconds. Systems of the 1990 era will provide increased capability for high-speed processing of data and will utilize increasing numbers of decision-aides, spreadsheets and AI tools. Users of these systems will be components of networks, linked via efficient communication systems to other users and other subsystems. These developments will lead to fundamental changes in the work place. Keywords: Interface; Artificial Intelligence; Systems; Feedback; Productivity; User Interface; Man-Machine; Cognitive.

35356 **(AD-A—163947/5/XAB) Reasoning in realtime for the pilot associate: an examination of a model-based approach to reasoning in realtime for artificial-intelligence systems using a distributed architecture. Master's thesis.** Norman, D.O. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Dec 1985. 159p. (AFIT/GCS/ENG—85D-12). NTIS, PC A08/MF A01.

The use of artificial intelligence (AI) techniques for pilot aiding in real-time (DoD Pilot Associate--PA) introduces some seemingly intractable problems. Most algorithms which will be used in a PA are search intensive with exponential-order-time-complexities. The thesis outlines the problem and explores the possibility of using parallel processing for minimizing the computational costs. Methods for, and results from, distributing data and functions among many processors are presented. An extension to the blackboard structure used in many AI systems called a virtual blackboard is introduced. The results and techniques are bundled into a prototype distributed data-flow constraint-network application system called DDAFCON. DDAFCON is discussed, and a flight-planning application is presented using DDAFCON. The results are discussed. It is shown that the maximum speedup due to parallel processing is bounded by the number of processors which a problem solution can accept. The thesis concludes that generalized AI structures and reasoning paradigms (specifically, deep models), although seemingly required for the performance level desired for applications such as the PA may not be realizable for many real-time applications. A change in emphasis for developing real-time AI systems is suggested.

35357 **(AD-A—164059/8/XAB) High performance parallel computing. Final report, 1 January-31 December 1983.** Browne, J.C.; Lipovski, G.J.; Malek, M. (Texas Univ., Austin (USA). Dept. of Computer Sciences). Dec 1985. 59p. NTIS, PC A04/MF A01.

The accomplishments of the research project High Performance Parallel Computing for the year 1983 span algorithm formulation, paralle programming languages, basic software for the Texas Reconfigurable Array Computer, and validation of design concpets for the Texas Reconfigurable Array Computer (TRAC). Image processing, sorting, and time-dependent partial differential equations were subjects for algorithm formulation and analysis. Accomplishments in parallel programming include: substantial progress toward the implementation of two parallel programming environments, the Computation Structures Language, and a task level data flow programming system. The hardware prototype of TRAC made substantial progress towards stability. The state-of-the-art in reconfigurable switch-based architectures was advanced. A result of note is the demonstration of the integration of circuit switching and packet switching in a single interconnection network.

35358 **(AD-A—164112/5/XAB) Parallel processing of region boundaries. Technical report.** Wu, Angela Y.; Bhaskar, S.K. (Maryland Univ., College Park (USA). Center for Automation Research). Nov 1985. 18p. (CAR-TR—159). NTIS, PC A02/MF A01.

A region may be represented by specifying the curves that bound it. When p processors are available, typical operations on regions so represented can be performed much faster than using a single processor. This paper presents parallel algorithms to determine properties of regions, such as area; to perform operations on regions, such as union and intersection; to determine if a point lies inside a region; and to determine whether a given digital curve could be the boundary of a region. Some of the algorithms involve sorting, the time complexity of which depends on the particular model of parallel computation used.

35359 **(AD-A—164171/1/XAB) Analysis and design of a parameterized protocol converter. Master's thesis.** (Naval Postgraduate School, Monterey, CA (USA)). Dec 1985. 109p. NTIS, PC A06/MF A01.

Designed to circumvent the incompatibilities between communicating computer systems, a parameterized protocol converter permits the use of communication equipment supporting variations of the same communication protocol or completely different framing technique protocols. The analysis of the conversion process includes the engineering trade-offs between speed of conversion and flexibility, and the use of an alternative flow architecture. Flexibility is enhanced through user selection of input and output protocol types, and the designation of functional specifics, such as code type, header length, and error detection methods, with variable parameters. The speed of conversion is increased through the parallel processing of the framing, transparency, and error control sub-functions and the use of a single-byte storage technique. The single-byte storage technique imposes some limitations in the use of transparent data.

35360 **(ANL/MCS-TM—68) ELEFUNT test results under X1.4 on the Encore Multimax.** Cody, W.J. (Argonne National Lab., IL (USA)). Apr 1986. Contract W-31-109-ENG-38. 12p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86010841.

Two libraries of Fortran test programs for elementary functions, MACHAR and ELEFUNT, were run on an Encore Multimax computer with 20 CPUs and 20 Megabytes of memory. The test program libraries were run under the X1.4 operating system (a version of 4.2 BSD UNIX). PARANOIA, an arithmetic test program, was run under the X1.2 operating system. Accuracy of the elementary functions, error detection, and error responses for the functions are discussed. 5 refs., 3 tabs. (DWL)

35361 **(ANL/MCS-TM—71) Paths to high-performance automated theorem proving.** Butler, R.; Lusk, E.; McCune, W.; Overbeek, R. (Argonne National Lab., IL (USA)). Apr 1986. Contract W-31-109-ENG-38. 12p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86011003.

Four components of a strategy for the implementation of high-performance automated theorem proving systems are presented. These are: (1) clause compilation, (2) multiprocessing, (3) database indexing, and (4) clause-set "compaction". Each of these tech-

niques are described and it is shown how they can be integrated into a coherent system with significantly higher performance than traditional systems. The strategy described has been implemented, and results are presented showing the effects of these techniques on Sam's Lemma, a relatively difficult theorem-proving problem. 15 refs.

35362 **(ANL/MCS-TM—72) Parallel logic programming for numeric applications.** Butler, R.; Lusk, E.; McCune, W.; Overbeek, R. (Argonne National Lab., IL (USA)). Apr 1986. Contract W-31-109-ENG-38. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011004.

This paper reports on a series of experiments involving the use of various dialects of parallel logic programming to express and control parallelism. The central goal of these experiments was to explore the possibility of writing numeric code for multiprocessors while expressing the synchronization requirements using logic programming. Three dialects of parallel logic programming are considered: Parlog, Delta-Prolog, and Flat Concurrent Prolog. The experiments involved the formulation of a well-known, highly-parallel algorithm in each of the three languages. In one case (Parlog, semi-manually compiled code for an implementation of an extended Warren Abstract Machine), a comparison is made of the performance of the resulting program with that of the same problem expressed in C, with monitors as the added parallelism construct. Speedups obtained for the C and Parlog versions are presented. The experiments illustrate the effect of granularity size on attainable degrees of parallelism. Based on the limited evidence from these experiments, conclusions are offered on the suitability of logic programming languages for programming multiprocessors. 16 refs., 2 tabs.

35363 **(ANL/TM—437) Using system transmittals at ANL.** Bolden, D.V. (Argonne National Lab., IL (USA)). Apr 1986. Contract W-31-109-ENG-38. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010964.

Instructions for using an electronic mail service at the Argonne National Laboratory are presented. Interface procedures, installation details, and transmittal machine processing for users of the system are described. Samples of menus, input and output code are provided. (DWL)

35364 **(CONF-8508173—2) ROSES: an efficient scheduler for precedence - constrained tasks on concurrent multiprocessors.** Barhen, J.; Halbert, E.C. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 26p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86011083.

From Conference on hypercube microprocessors; Knoxville, TN, USA (1 Aug 1985).

CESAR/86-21.

One of the first steps in attempting to solve a problem on a concurrent computation ensemble is its decomposition into a set of tasks (or processes). Problem decomposition often induces precedence constraints among the tasks, which the distributed nature of the computational system translates into message passing requirements. The efficient scheduling of sets of tasks among which complex interrelationships (such as precedence constraints) may exist is essential for achieving optimal performance from the new generation of concurrent supercomputers. This paper focuses on the ROSES system, which is being developed to schedule precedence-constrained tasks for computation by an ensemble of concurrent processors. This endeavor is particularly difficult when the number of tasks required exceeds the number of available processors, of when the interconnection topology of the task graph differs from the interconnection topology of the computation ensemble. The ROSES approach seeks near-optimal solutions by combining heuristic techniques to minimize scheduling time as a function of the number and relationship of tasks, with sophisticated data structures to most efficiently utilize available computer memory, and algorithms to control search and eliminate dead ends. The methodology is applied to the solution of the inverse dynamics equations of a robot manipulator and benchmark results are included. 51 refs., 1 fig., 5 tabs.

35365 **(DOE/ER/02383—0122) Computational methods and software for differential equations and their applications. Annual report, November 16, 1985-November 15, 1986.** (Illinois Univ., Urbana (USA). Dept. of Computer Science). 1986. Contract AC02-76ER02383. 23p. (COO—2383-0122). NTIS, PC A02/MF A01; GPO Dep. File Number DE86010231.

Research efforts in algorithms, numerical software, and support software are described. The theory and implementation of adaptive methods for differential equations in various forms have been studied. The use of iterative methods in this environment and parallel techniques for ordinary differential equations have also been investigated. An introduction to the design and development of three tools to aid in scientific software development are presented. These tools are Polylith, a system which permits rapid prototyping of interconnected software modules; Fred, a syntax-directed, screen-oriented editor that can be used for any textual objects (programs, documentation, etc.); and a mathematical expression editor which permits easy modification of expressions in graphic form while retaining an internal structure that permits translation of other useful forms such as a computer language. (DWL) 38 refs.

35366 **(DOE/ER/03077—272) Bifurcation of tracked scalar waves.** Glimm, J.; Grove, J.; Lindquist, B.; McBryan, O.A.; Tryggvason, G. (New York Univ., NY (USA). Courant Mathematics and Computing Lab.). May 1986. Contract AC02-76ER03077. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011524.

The dynamic evolution of tracked waves by a front-tracking algorithm may lead on either numerical or physical grounds to intersections of the waves. The correct resolution of these intersections is described locally by the solution of Riemann problems and requires a bifurcation of the topology defined by the tracked waves. An algorithm is described which is appropriate for the resolution of scalar tracked waves, such as material discontinuities, contact dicontinuities in gas dynamics, or constituent concetration waves including oil-water banks in oil reservoirs Even here the algorithm is not fully general, and the resolution of the intersections of an arbitrary set of curves in the plane for the above range of physical problems remains unsolved. However with the assumption that the set of intersections to be resolved is a small perturbation (resulting for example from a small time step in an evolution) of a valid, non-intersecting front, the algorithm seems to be general. In any case examples will be presented that show that complicated interfaces can be generated automatically from simple ones through successive bifurcations. 15 refs., 9 figs.

35367 **(DOE/ER/10358—T1) Research in the design and implementation of a comprehensive facility for scientific computation. Final project report.** Fateman, R.J.; Kahan, W. (California Univ., Berkeley (USA). Center for Pure and Applied Mathematics). 1983. Contract AT03-79ER10358. 19p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86010906.

Research on ways to organize a body of numerical procedures in such a way that they may be invoked automatically by processes which accept symbolic and algebraic specifications from a user, and produce combined symbolic, numeric and graphical output is described. Efforts are made to make these algebraic systems as flexible and useful as possible in this context, and to integrate them successfully into a man-machine design which provides operating system, language, and algorithm support. Various aspects of this research are reviewed including languages for symbolic algebra systems, programming environments, numerical software, numeric/symbolic programs, floating point hardware, elementary functions, Macsyma distribution, VAX/Macsyma/computer architecture, interactive systems, Lisp language, and advanced computer concepts (supercomputers). The computing environment for this research are UNIX-VAX-11/780, Vax 11/750, and Motorola 68000 systems. 32 refs. (DWL)

35368 **(DOE/ER/13283—4) Integrated testing and analysis of mathematical software tools. Summary of research activities, 1 August 1985-1 May 1986.** Osterweil, L. (Colorado Univ., Boulder (USA)). 1986. Contract FG02-84ER13283. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010882.

Work in each of the three main thrusts which have been pursued during the past year is addressed: (1) the large scale integration of software tools into effective software environments, (2) the effective integration of debugging, testing and analysis tools and aids, and (3) the creation of effective user interfaces to testing, debugging and analysis tools exploiting high resolution interactive graphics workstations.

35369 **(DOE/ER/13283—5) Software process interpretation and software environments.** Osterweil, L. (Colorado Univ., Boulder (USA). Dept. of Computer Science). Apr 1986. Contract FG02-84ER13283. 58p. (CU-CS—324-86). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86010881.

This paper suggests that software engineering must become the study of how to formalize, specify, and automate the complex processes by which software products are synthesized. The author believes that software systems are most profitably thought of as products of large and complex manufacturing and fabrication processes which can be described, automated, and controlled by familiar algorithmic programming techniques. Included in this paper are discussions of programming software engineering processes, the relations of the author's research to other computer science research areas, and the design of a software engineering language. 42 refs., 9 tabs.

35370 **(DOE/ER/13283—6) Odin environment integration mechanism.** Clemm, G.; Osterweil, L. (Colorado Univ., Boulder (USA). Dept. of Computer Science). Apr 1986. Contract FG02-84ER13283;AC02-80ER10718. 95p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86010878.

A method of integrating software development tools is described. A data centered approach is taken, the software objects residing in a software object (data) repository. Odin can be thought of as an interpreter for a high level command language whose operands are the various software objects in the data repository and whose operators are the various tool fragments used to construct the software tools. Software objects can be such tools as source code, parse trees, symbol tables, flow graphs, documentation, test data, test results, and program structure representations. Discussions of previous research, Odin architecture, design, the Odin request language, the Odin specification language, and an example of Odin implementation are presented. 45 refs., 8 figs. (DWL)

35371 **(DOE/ER/13283—8) Exploration tool for ObjTalk inheritance structures. The Browser.** Rathke, C. (Colorado Univ., Boulder (USA). Dept. of Computer Science). 1986. Contract FG02-84ER13283. 8p. Dept. of Computer Science, University of Colorado, Boulder. File Number TI86010880.

The Browser is a tool for exploring hierarchical systems by providing visualizations of structure and content of the system's objects. The user must have some knowledge of ObjTalk in order to make use of the information provided by the Browser. The Browser uses the window-, menu- and icon-subsystem of the Wlisp environment. Inheritance hierarchies of ObjTalk classes can be shown using graphical representations. The definition of slots and methods can be inspected. 7 figs. (DWL)

35372 **(EGG-M—29885) Issues in expert system aids for a large engineering simulation code.** Fink, R.K.; Callow, R.A.; Ransom, V.H. (EG and G Idaho, Inc., Idaho Falls (USA)). 1986. Contract AC07-76ID01570. 6p. (CONF-860729—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86009098.

From Summer computer simulation conference; Reno, NV, USA (28 Jul 1986).

Coupling expert systems with existing engineering analysis codes is a promising area for artificial intelligence applications. An expert system can provide ready access to a knowledge base larger than most individual analysts would possess and thus can provide for easier and less costly use of the code and also reduce the potential for code misuse. The functions appropriate for expert system assistance and some of the issues that arise in developing such systems that have been identified through experimentation with the ATHENA code, a large digital simulation code for analysis of thermal-hydraulic energy networks, are discussed. The use of an expert system as a front-end user interface to analysis codes is conceptually appealing and with obvious benefits. Expert systems can play a substantial role in the execution and output analysis phases of simulation code usage. The integration of these roles leads to the concept of an intelligent environment for simulation code usage. The knowledge specific to the particular system being modeled, including modeling abstraction decisions, and specific knowledge about the numerical solution methods of the code can be used for more effective code execution control and output diagnosis. Expected benefits are improved quality of results and/or reduced execution cost. The methods for using this knowledge in an intelligent environment are discussed, with applications to current codes as well as implications for archtecture of future large engineering simulation codes. 4 refs., 2 figs.

35373 **(LA-UR—86-1179) Programming a massively parallel, computation universal system: static behavior.** Lapedes, A.; Farber, R. (Los Alamos National Lab., NM (USA)). 1986. Contract W-7405-ENG-36. 26p. (CONF-8604173—1). NTIS, PC A03/MF A01; GPO Dep. File Number DE86010171.

From Neural nets and computation conference; Snowbird, UT, USA (1 Apr 1986).

In previous work by the authors, the "optimum finding" properties of Hopfield neural nets were applied to the nets themselves to create a "neural compiler." This was done in such a way that the problem of programming the attractors of one neural net (called the Slave net) was expressed as an optimization problem that was in turn solved by a second neural net (the Master net). In this series of papers that approach is extended to programming nets that contain interneurons (sometimes called "hidden neurons"), and thus deals with nets capable of universal computation. 22 refs.

35374 **(ORNL—4972) Morse Monte Carlo Radiation Transport Code System.** Emmett, M.B. (Oak Ridge National Lab., TN (USA)). Feb 1975. Contract AC05-84OR21400. 344p. NTIS, PC A15. File Number DE86006924.

The report contains sections containing descriptions of the MORSE and PICTURE codes, input descriptions, sample problems, deviations of the physical equations and explanations of the various error messages. The MORSE code is a multipurpose neutron and gamma-ray transport Monte Carlo code. Time dependence for both shielding and criticality problems is provided. General three-dimensional geometry may be used with an albedo option available at any material surface. The PICTURE code provide aid in preparing correct input data for the combinatorial geometry package CG. It provides a printed view of arbitrary two-dimensional slices through the geometry. By inspecting these pictures one may determine if the geometry specified by the input cards is indeed the desired geometry. 23 refs. (WRF)

35375 **(ORNL—6260) Computer software evaluation methodology and data base management system selection.** Huntley, A.F. (Oak Ridge National Lab., TN (USA)). Apr 1986. Contract AC05-84OR21400. 45p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86011343.

This document presents a Data Base Management System (DBMS) evaluation methodology that has been developed under the sponsorship of the Department of the Navy, Naval Management Systems Support Office (NAVMASSO), Norfolk, Virginia. NAVMASSO has recognized the need for a DBMS to support the Shipboard Nontactical Automated Data Processing Program (SNAP) and has tasked Oak Ridge National Laboratory (ORNL) with evaluating DBMSs that are available for the SNAP-I computer system - a Honeywell DPS-6 minicomputer - and the SNAP-II computer system - a Harris 300 minicomputer. In preparation for the SNAP-I/SNAP-II DBMS evaluation, ORNL has developed the DBMS evaluation methodology presented in this document. First, a discussion of the traditional computer software evaluation method-

ology is provided, with identification of aspects of the methodology that may cause the resulting evaluation to be deficient. A DBMS evaluation methodology that stresses the layered functionality of the software is then presented. The methodology requires a large amount of hands-on testing and allows evaluation team members to evaluate the software from the perspective of application developers and end-users who will use the system on a day-to-day basis. The document contains a discussion of several general considerations that must be evaluated. These are items that form a supportive environment and enhance the usability of the software, even though they may not affect the intrinsic functionality of the software. The technical facilities that define the limits of functionality of the software are then presented for evaluation. Areas where these facilities may not meet the desired functionality are identified. 14 refs.

35376 **(ORNL—6269) Approach to the Navy's Shipboard Nontactical ADP Program (SNAP) data communications needs.** Hammons, C.E.; Stewart, C.R. (Oak Ridge National Lab., TN (USA)). May 1986. Contract AC05-84OR21400. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011340.

The ARPANET/MILNET Defense Data Network (DDN) communications link with the Shipboard Nontactical ADP Program (SNAP) computers is a research project being conducted by ORNL in support of the Navy's nontactical computing efforts. The purpose of the project is to investigate the feasibility of application of state-of-the-art (SOA) data communications techniques to the SNAP systems as deployed on board Navy ships. (Two systems have been approved - the Honeywell DPS6 family of processors known as SNAP-I and the Harris 300 series systems known as SNAP-II.) The installation of high-speed electronic computer networking capabilities has traditionally had a synergistic effect on the processing of data because operations that were previously not feasible due to data transfer logistics have become feasible. The most desirable situation would be one in which the computer networking speed and flexibility rivaled that of local computer operations. While networking of this caliber has not yet been achieved in a practical way, the advances that have been made more than offset the effort required to bring this desirable capability to SNAP.

35377 **(ORNL/TM—9901) Study of UNIX and its suitability for the Air Force's WWMCCS Information System.** Loffman, R.S. (Oak Ridge National Lab., TN (USA)). Apr 1986. Contract AC05-84OR21400. 22p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86011293.

The US Department of Defense is in the process of modernizing its Worldwide Military Command and Control System (WWMCCS) Automatic Data Processing (ADP) system. This modernization will include a new ADP system: WWMCCS Information System (WIS). The need for modernization results from a rapid growth in technology and an increased dependency on ADP support. The Air Force's role in this effort is the modernization of the Air Force WIS (AFWIS). The Air Force requested the assistance of Oak Ridge National Laboratory (ORNL) in investigating UNIX as a possible operating system for its new WIS ADP environment. ORNL reviewed and analyzed (1) WWMCCS documentation for system requirements, (2) technical materials for information about UNIX, and (3) business sources for indications about UNIX's future in a commercial market. This analysis concluded that there are some features required by AFWIS that currently only UNIX can provide; however, its place in the future marketplace is still uncertain. 8 refs.

35378 **(SAND—86-0259) Design guidelines for human-computer dialogues.** Chao, B.P. (Sandia National Labs., Albuquerque, NM (USA)). May 1986. Contract AC04-76DP00789. 40p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86011543.

This report presents a set of guidelines for designing human-computer dialogues. User requirements, dialogue modes, entry devices, error management and recovery, and data loss protection and disaster prevention are discussed, and a checklist for dialogue design is provided. 15 refs., 5 figs., 1 tab.

35379 **(SAND—86-0499C) Prototype material properties data network.** Northrup, C.J.M. Jr.; McCarthy, J.L.; Westbrook, J.H.; Grattidge, W. (Sandia National Labs., Albuquerque, NM (USA); Lawrence Berkeley Lab., CA (USA); Sci-Tech Knowledge Systems, Scotia, NY (USA)). 1986. Contract AC04-76DP00789. 10p. (CONF-860722—7). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86007821.

From ASME pressure vessel and piping conference and exhibit; Chicago, IL, USA (20 Jul 1986).

The Scientific Information Research Program (SIRP) is a cooperative program initiated by the National Bureau of Standards and the Department of Energy to develop a prototype, computerized information network. Subsequent support has been provided by the National Aeronautical and Space Administration and the Department of Defense. A group of engineers and scientists were selected from Lawrence Livermore National Laboratory, Los Alamos National Laboratory and Sandia National Laboratories to form an initial user group and provide guidance in the development of the system. After an intensive analysis, it was determined that the information the Group used most frequently was the physical properties of metal alloys. This data is the focus for the database system, Materials Information for Science and Technology (MIST), being developed for the network. 3 refs., 1 tab.

35380 **(SAND—86-0564) GOMER: a PC-based expert system.** Cochrell, G.D. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1986. Contract AC04-76DP00789. 57p. NTIS, PC A04/MF A01; GPO Dep. File Number DE86011672.

The algorithm for a PC-based expert system for interpretation of seismic data from remote sensors is described. The original expert system was written on a Symbolics computer using Zeta LISP. The PC version is written in Pascal and runs on the IBM PC or on any IBM-compatible computer. The Pascal source code is included with this report. To date the software has been used only on simulated sensor data but will be modified to accept data from fielded sensors. Extensive field testing will be required to refine the program's knowledge base. 8 figs.

35381 **(SLAC—297) VM version of INTERLAN's NS4240 Xerox ITP Network Software.** Frese, H.; Cottrell, R.L.; Downey, T. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Apr 1986. Contract AC03-76SF00515. 43p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86008139.

This manual describes Stanford Linear Accelerator Center's VM adaptation of INTERLAN's NS4240 ITP Network Software. The ITP Network Software is an implementation of the Xerox Network Systems Internet Transport Protocols. The ITP Network Software runs under the VM/SP operating system. This manual assumes familiarity with the use of the VM operating system. The user is also expected to have experience in assembling, linking, and running application programs on a system. The user should be familiar with the concepts of computer networking and have an understanding of the more specific concepts of Ethernet-based networks. 10 refs.

35382 **(SOL—86-6) Some theoretical properties of an augmented lagrangian merit function.** Gill, P.E.; Murray, W.; Saunders, M.A.; Wright, M.H. (Stanford Univ., CA (USA). Systems Optimization Lab.). Apr 1986. Contract AS03-76ER72018. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86011330.

Sequential quadratic programming (SQP) methods for nonlinearly constrained optimization typically use of a merit function to enforce convergence from an arbitrary starting point. We define a smooth augmented Lagrangian merit function in which the Lagrange multiplier estimate is treated as a separate variable, and inequality constraints are handled by means of non-negative slack variables that included in the linesearch. Global convergence is proved of an SQP algorithm that uses merit function. It is also prove, that steps of unity are accepted in a neighborhood of the solution when this merit function is used in a suitable superlinearly convergent algorithm. Finally, a selection of numerical results is

presented to illustrate the performance of the associated SQP method. 36 refs., 1 tab.

35383 **(UCID—20664) Computer science research. Computation and Information Services Directorate.** McGraw, J.R.; Van Dyke, P.T. (eds.). (Lawrence Livermore National Lab., CA (USA)). 1985. Contract W-7405-ENG-48. 58p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86010492.

Research activities in computer science and numerical analysis carried out within the Computation and Information Services Directorate of Lawrence Livermore National Laboratory are highlighted. A technical introduction to current areas of study is given, and recent progress is reported. Current research features a heavy emphasis on multiprocessing, which plays a major role in nearly every proposed new supercomputer system. In addition to multiprocessing, strong efforts continue in some of the more traditional areas of computer science, particularly numerical methods. Specific content of the report includes chapters on numerical algorithms, software interfaces, architectures and networks, future directions, project funding, and project contacts. (DWL)

35384 **(UCRL—15797) Technique for obtaining source distribution intensities by deconvolving experimental Pinex data using expansions of associated Legendre functions.** Green, J.; Martintelli, E.A. (Lawrence Livermore National Lab., CA (USA)). Aug 1985. Contract W-7405-ENG-48. 18p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86011513.

The interpretation of experimental Pinex film data is investigated. An algorithm for determining the intensity of a radiation source from film density evidence is developed. 1 fig. (DWL)

35385 **(UCRL—15800) Integrated simulation investigation.** Smith, D.M. (Scientific Simulation, Inc., Albuquerque, NM (USA)). 29 Mar 1985. Contract W-7405-ENG-48. 43p. (SSI-TR—1900/201). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86010551.

Methods of combining the models employed by the Optical Analysis Simulation for Interactive Systems (OASIS) and Interactive Design Executive Architecture (IDEA) into a single data base accessible by either code are identified. Specifically the purpose of the study is to combine OASIS and IDEA into a single code. The methods evaluated include physical merging of the executives, modification of one or both executives and a modification of one of one or both model bases. For each method, the following aspects were investigated: necessary software changes, benefits of the method, and limitations of the method. 7 tabs.

35386 **(UCRL—94333) Database algorithms for multiprocessor and very large memory systems.** Thompson, W.C. III. (Lawrence Livermore National Lab., CA (USA)). 18 Mar 1986. Contract W-7405-ENG-48. 26p. (CONF-860740—1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86009406.

From Syracuse University Minnowbrook workshop on data base machines; Blue Mountain Lake, NY, USA (22 Jul 1986).

Many recent computer designs exhibit two features which have been too expensive to exploit previously. The first, very large main memories, may allow significant portions of databases to be kept in main memory. The second, parallel processing, provides multiple processors to speed the operations on databases in memory. A recent paper by DeWitt et. al. discusses the effect of providing a very large main memory in a computer for database operations. This paper explores the algorithms appropriate for relational operations when large main memories and parallel processors are provided. 9 refs., 7 figs.

35387 **Cellular-automata supercomputers for fluid-dynamics modeling.** Margolus, N.; Toffoli, T.; Vichniac, G. (Laboratory for Computer Science, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Physical Review Letters;* **56**: No. 16, 1694-1696(21 Apr 1986). Contract AC02-83ER13082.

We report recent developments in the modeling of fluid dynamics, and give experimental results (including dynamical exponents) obtained using cellular automata machines. Because of their locality and uniformity, cellular automata lend themselves to an extremely efficient physical realization; with a suitable architecture, an amount of hardware resources comparable to that of a home computer can achieve (in the simulation of cellular automata) the performance of a conventional supercomputer.

35388 **Status of supercomputing in Europe.** Duff, I.S. (Argonne National Lab.). pp 4 of Proceedings of an international meeting on advances in nuclear engineering computational methods. Volume 1. LaGrange Park, IL; American Nuclear Society (1985). (CONF-850411—).

From International meeting on advances in nuclear engineering computational methods; Knoxville, TN, USA (9 Apr 1985).

There are now over thirty supercomputers being used in scientific research in Europe. The authors discuss the reasons why sites need this computing power and the major application areas in which supercomputers are used. In each area they consider both the difficulties and advantages of using supercomputers. Included in the talk are summaries of arguments used in supercomputer procurement and in the selection of supercomputer. They also discuss a recent initiative to set up a European Centre for Supercomputing and indicate why they believe there is a healthy future for supercomputing in Europe.

35389 **Using HASS to support the joint audit system.** Jensen, R.J.; Hall, C.J. (Rockwell Hanford Operations, Richland, WA). pp 7186 of Computer applications in health physics. Kathren, R.L.; Higby, D.P.; McKinney, M.A. Richland, WA; Health Physics Society (1984). (CONF-840202—).

From 17. midyear topical meeting of the Health Physics Society; Pasco, WA, USA (5 Feb 1984).

HASS, the Hanford Automatic Scheduling System, supported by Boeing Computer Services is a powerful tool for scheduling projects. HASS requires a large number of cards in the input deck and for this reason is awkward to use. Therefore, a Fortran program was written on the UNIVAC 1100/44 which creates a HASS input deck for the Joint Audit Schedules at Rockwell Hanford Operations (RHO). The Joint Audit System at RHO can involve as many as six organizations at one time, each responsible for a series of scheduled activities (entrance briefing, field work, exit briefing, preliminary report, etc.). Use of the front end Fortran program enables HASS to perform all of the necessary computations and generates the desired schedule which integrates all organizations according to audit activity. The Fortran program has approximately 6000 lines of output. The HASS system, in conjunction with the front end programming, has been used to quickly and accurately generate an annual joint audit schedule at RHO, a process which would otherwise be time and manpower consuming.

9903 Information Handling

35390 **(DOE/TIC—4585-R5) Corporate Author Entries. Revision 5.** Hendricks, P.L. (ed.). (USDOE Office of Scientific and Technical Information, Oak Ridge, TN). May 1986. 973p. NTIS, PC A99/MF A01; GPO Dep. File Number DE86007602.

This reference authority has been created and is maintained to provide standard forms for recording the names of organizations consistently in bibliographic citations. This revision includes approximately 42,000 entries established since 1973.

35391 (INIS-mf—10111, pp 35) **Instructions for writing abstracts.** Pavlickova, J. (Ceskoslovenska Komise pro Atomovou Energii, Zbraslav nad Vltavou. Ustredni Informacni Stredisko pro Jaderny Program). May 1985. (In Czech). NTIS (US Sales Only), PC A03/MF A01. File Number DE86701997. (CONF-8505256—Absts.).

From IAA conference on instrumental activation analysis; Klucenice, Czechoslovakia (12 May 1985).

9905 Civilian Defense

35392 **(CONF-8605113—1) Role of civil defense, 1986.** Chester, C.V. (Oak Ridge National Lab., TN (USA)). 1986. Contract AC05-84OR21400. 20p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86010618.

From Conference on ballistic missile defense and arms control; Washington, DC, USA (12 May 1986).

The technology of protecting people from nuclear weapons is well-developed and is being deployed by several countries including Switzerland, Sweden, Norway, Finland, the Soviet Union, and China. However, the United States, where most of the technology originated, has so far refused to make the investment necessary to provide significant passive protection for its citizens. Instead it has relied entirely on nuclear deterrence to prevent attack. The proposed Strategic Defense Initiative has reopened the debate on strategic defense. The US has several options for civil defense programs but the low-cost programs require several days warning for evacuation. A competent program protecting people in blast areas with only tactical warning would be cost effective at the margin with respect to offensive forces but would still cost 1% of the annual defense budget for 20 years. The fate of Reagan's attempt to expand the civil defense program suggests that this level of expenditure for passive defense is not politically feasible in the present climate. Most knowledgeable observers believe that any active defense will leak, and that a passive defense underlayer will be required to reduce casualties from the leakage. It is possible that a decision to deploy active defense costing hundreds of billions of dollars (over 20 years) will make possible the expenditure of tens of billions of dollars for passive defense. It is suggested here that a US civil defense program will not make arms control more difficult. Most likely it will have little effect. It may provide some hedge against cheating, and make the corresponding risks in arms control agreements politically more acceptable.

CORPORATE AUTHOR INDEX

In the Corporate Author Index, report literature is indexed using the name of the organization or institution responsible for issuing the report. Headings are provided for all report literature and for published literature for which a corporate approach is especially desirable, e.g., symposium and conference proceedings.

Each entry under a corporate heading gives the document title and the volume and abstract numbers. The document type, e.g., R for Report; country of publication, e.g., US; and language of the document, e.g., In German, are given in parentheses at the end of the entry. If no language statement appears, the language is English. Tables of document types and country of publication codes appear after the indexes.

DOE Energy Data Base: Corporate Author Entries (DOE/TIC-4585) is used in the standardization of corporate entries. DOE/TIC-4585 is available for purchase from the National Technical Information Service (NTIS), U. S. Department of Commerce, Springfield, Virginia 22161.

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The notations in the final parentheses indicate the type of document, e.g., R for Report; the country of publication, e.g., US; and the language if other than English, e.g., In German. Tables of document types and country of publication codes appear after the indexes.

The title may be supplemented with additional words, or a phrase, if it appears additional information would be helpful. In cases for which the title contains little or no information related to the subject entry, it may be replaced entirely by the supplementary information. A qualifier is not always required, and in such cases the title will follow the unqualified subject descriptor.

The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processes applied to, the subject term.

Index entries are selected to indicate the important ideas and concepts presented in a document, rather than words that may appear in the text. Within the available thesaurus terms, the most probable or logical place to look for typical information is selected. "See references" are included to guide users from synonymous terms or phrases to the descriptor selected as a subject heading for the concept (e.g., Pipeline Quality Gas, see HIGH BTU GAS). "See also references" are used to indicate where to find references to subject concepts that are narrower, broader, or related to a particular subject heading. To complete an exhaustive search of a given subject, all such headings should be reviewed. Copies of DOE/TIC-7000, the Subject Thesaurus, are available from the National Technical Information Service (NTIS), U.S. Department of Commerce, Springfield, VA 22161.

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AC21-84MC21391	Southwest Research Inst., San Antonio, TX (USA)	
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AC21-85MC22064	Science Applications International Corp., Chatsworth, CA (USA)	
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AC22-76ET10532	Chevron Research Co., Richmond, CA (USA)	
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AC79-83BP13795	Pacific Northwest Labs., Richland, WA (USA)	
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AI01-76ET10393	NCB (IEA Grimethorpe) Ltd., Grimethorpe, Barnsley, South Yorkshire (UK)	
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FC22-83FE60149	**National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)**	
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FG03-85SF15799	**Hawaii Univ., Honolulu (USA). Hawaii Natural Energy Inst.**	
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FG03-86ER52130	**California Univ., Los Angeles (USA). Dept. of Mechanical, Aerospace and Nuclear Engineering**	
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FG22-84PC70790	**Polytechnic Inst. of New York, Brooklyn (USA)**	
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CONF-8508117-	(14. international colloquium on group theoretical methods in physics, Seoul, Korea, 26-30 Aug 1985)				
3	*See* DESY-85-136		DE86752061	MN -34D	11:35095
4	*See* DESY-85-111		DE86752062	MN -34D	11:35097
CONF-8508173-	(Conference on hypercube microprocessors, Knoxville, TN, USA, 1 Aug 1985)				
2	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86011083	MN -32	11:35364
CONF-850927-	(12. European conference on controlled fusion and plasma physics, Budapest, Hungary, 2-6 Sep 1985)				
Exc.	*See* IPP-III/107		DE86752047	MN -20a	11:35235
CONF-850942-	(190. American Chemical Society national meeting, Chicago, IL, USA, 8-13 Sep 1985)				
35	*See* PNL-SA-12937	E 1.99:	DE86011325	MN -4	11:34398
CONF-850982-	(2. annual Pittsburgh coal conference, Pittsburgh, PA, USA, 16-20 Sep 1985)				
3	*See* IS-M-569		DE86011435	MN -90d	11:33551
CONF-8509212-	(2. international workshop on lung dosimetry, Cambridge, England, 2-6 Sep 1985)				
4	*See* PNL-SA-12650	E 1.99:	DE86010939	MN -41	11:34940
CONF-8509255-	(Synchrotron radiation sources and their applications conference, Aberdeen, Scotland, 14-18 Sep 1985)				
1-Rev.	*See* LBL-20834-Rev.	E 1.99:	DE86009951	MN -28	11:34643
CONF-851003-	(Conference on coal science, Sydney, Australia, 28 Oct-1 Nov 1985)				
19	*See* IS-M-558	E 1.99:	DE86011431	MN -90a	11:33638
CONF-8510218-	(Field data acquisition for building and equipment energy-use monitoring national workshop, Dallas, TX, USA, 16 Oct 1985)				
4	*See* LBL-20236	E 1.99:	DE86011306	MN -95d	11:34191
CONF-8510237-	(DOE symposium on engineering energy sciences, State College, PA, USA, 11 Oct 1985)				
2	*See* EGG-M-0885	E 1.99:	DE86011036	MN -25	11:34274
CONF-8510308-	(Gas sampling calorimetry workshop, Batavia, IL, USA, 31 Oct-1 Nov 1985)				
2	*See* RAL-86-007		TI86901310	ND -28	11:34673
CONF-851102-	(11. symposium on engineering problems in fusion research, Austin, TX, USA, 18-22 Nov 1985)				
109	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011064	MN -20b	11:35281
CONF-851115-	(American Nuclear Society winter meeting, San Francisco, CA, USA, 10-15 Nov 1985)				
	Trans. Am. Nucl. Soc., 50: 594(Nov 1985)				11:33759
	Trans. Am. Nucl. Soc., 50: 596(Nov 1985)				11:33760
	Trans. Am. Nucl. Soc., 50: 584-585(Nov 1985)				11:33830
	Trans. Am. Nucl. Soc., 50: 590-592(Nov 1985)				11:33831
	Trans. Am. Nucl. Soc., 50: 596-597(Nov 1985)				11:33832
	Trans. Am. Nucl. Soc., 50: 598(Nov 1985)				11:33833
	Trans. Am. Nucl. Soc., 50: 477-479(Nov 1985)				11:33861
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	Trans. Am. Nucl. Soc., 50: 259(Nov 1985)				11:34007
	Trans. Am. Nucl. Soc., 50: 606-607(Nov 1985)				11:34016
	Trans. Am. Nucl. Soc., 50: 612-613(Nov 1985)				11:34017
	Trans. Am. Nucl. Soc., 50: 445-446(Nov 1985)				11:34021
	Trans. Am. Nucl. Soc., 50: 590-592(Nov 1985)				11:34035
	Trans. Am. Nucl. Soc., 50: 614-615(Nov 1985)				11:34036
	Trans. Am. Nucl. Soc., 50: 438-440(Nov 1985)				11:34043
	Trans. Am. Nucl. Soc., 50: 585-586(Nov 1985)				11:34044
	Trans. Am. Nucl. Soc., 50: 598-599(Nov 1985)				11:34045
	Trans. Am. Nucl. Soc., 50: 599-600(Nov 1985)				11:34046
	Trans. Am. Nucl. Soc., 50: 600-601(Nov 1985)				11:34047
	Trans. Am. Nucl. Soc., 50: 444(Nov 1985)				11:34076
	Trans. Am. Nucl. Soc., 50: 444-445(Nov 1985)				11:34077
	Trans. Am. Nucl. Soc., 50: 446-447(Nov 1985)				11:34078

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	Trans. Am. Nucl. Soc., 50: 449-450(Nov 1985)			11:34079
	Trans. Am. Nucl. Soc., 50: 450-451(Nov 1985)			11:34080
	Trans. Am. Nucl. Soc., 50: 451-452(Nov 1985)			11:34081
	Trans. Am. Nucl. Soc., 50: 452-453(Nov 1985)			11:34082
	Trans. Am. Nucl. Soc., 50: 457-458(Nov 1985)			11:34083
	Trans. Am. Nucl. Soc., 50: 472-473(Nov 1985)			11:34084
	Trans. Am. Nucl. Soc., 50: 616(Nov 1985)			11:34085
	Trans. Am. Nucl. Soc., 50: 616-618(Nov 1985)			11:34086
	Trans. Am. Nucl. Soc., 50: 618-619(Nov 1985)			11:34087
	Trans. Am. Nucl. Soc., 50: 619-620(Nov 1985)			11:34088
	Trans. Am. Nucl. Soc., 50: 620-621(Nov 1985)			11:34089
	Trans. Am. Nucl. Soc., 50: 621(Nov 1985)			11:34090
	Trans. Am. Nucl. Soc., 50: 621-622(Nov 1985)			11:34091
	Trans. Am. Nucl. Soc., 50: 626-628(Nov 1985)			11:34092
	Trans. Am. Nucl. Soc., 50: 630-631(Nov 1985)			11:34093
	Trans. Am. Nucl. Soc., 50: 631-633(Nov 1985)			11:34094
	Trans. Am. Nucl. Soc., 50: 635-637(Nov 1985)			11:34095
	Trans. Am. Nucl. Soc., 50: 637-638(Nov 1985)			11:34096
	Trans. Am. Nucl. Soc., 50: 640-641(Nov 1985)			11:34097
	Trans. Am. Nucl. Soc., 50: 641-643(Nov 1985)			11:34098
	Trans. Am. Nucl. Soc., 50: 6(Nov 1985)			11:34170
	Trans. Am. Nucl. Soc., 50: 581-582(Nov 1985)			11:34533
	Trans. Am. Nucl. Soc., 50: 582-584(Nov 1985)			11:34534
	Trans. Am. Nucl. Soc., 50: 586-587(Nov 1985)			11:34535
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	Trans. Am. Nucl. Soc., 50: 453-454(Nov 1985)			11:35335
	Trans. Am. Nucl. Soc., 50: 454-457(Nov 1985)			11:35336
CONF-851185-	(International laser science conference, Dallas, TX, USA, 18-22 Nov 1985)			
19	*See* K/TS-11-703	E 1.99: DE86011408	MN -38	11:33749
CONF-8511130-	(4. international RETRAN meeting, Tampa, FL, USA, 11-13 Nov 1985)			
	See EPRI-NP-4558-SR	TI86920290	ND -78	11:34057
CONF-8511136-	(Direct liquefaction contractors conference, Pittsburgh, PA, USA, 19-21 Nov 1985)			
6	*See* PNL-SA-13418	E 1.99: DE86011116	MN -90d	11:33655
CONF-851272-	(Conference on RS Ophiuchi and the recurrent nova phenomenon, Manchester, England, 1 Dec 1985)			
2	*See* LA-UR-86-1216	E 1.99: DE86010175	MN -34B	11:35013
CONF-860148-	(2. United States/Mexico cooperative symposium on atomic and molecular physics, Cocoyoc, Mexico, 1 Jan 1986)			
7	*See* LBL-21223	E 1.99: DE86011315	MN -20d	11:35303
CONF-860150-	(Winter condensed matter physics conference: frontiers in condensed matter X-ray physics, Aspen, CO, USA, 19-25 Jan 1986)			
3	*See* SLAC-PUB-3951	E 1.99: DE86011158	MN -34D	11:35092
CONF-860156-	(1. workshop on pollutant transport and accumulation in a multimedia environment, Los Angeles, CA, USA, 22-24 Jan 1986)			
2	*See* UCRL-93068	E 1.99: DE86010157	MN -41	11:34728
CONF-860272-	(Wire chamber conference, Vienna, Austria, 25-28 Feb 1986)			
8	*See* CERN-EP-86-36	DE86901425	MN -28	11:34652
9	NTIS (US Sales Only), PC A03/MF A01; 1	DE86901423	MN -28	11:34654
10	*See* CERN-EP-86-40	DE86901426	MN -28	11:34653
11	*See* CERN-EP-86-39	E 1.99: DE86010912	MN -28	11:34627
CONF-860304-	(Corrosion '86, Houston, TX, USA, 17-21 Mar 1986)			
8	*See* PNL-SA-13349	TI86011324	MN -25	11:34286
CONF-860316-	(Topical meeting on short wavelength coherent radiation, Monterey, CA, USA, 24-27 Mar 1986)			
8	*See* LA-UR-86-1682	E 1.99: DE86011248	MN -38	11:34556
CONF-860317-	(Waste management '86, Tucson, AZ, USA, 2-6 Mar 1986)			
48	*See* PNL-SA-13415	E 1.99: DE86010934	MN -85	11:33825
50	*See* PNL-SA-13364	E 1.99: DE86011141	MN -70	11:33824

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CONF-860324-	(High temperature plasma diagnostics, Hilton Head Island, SC, USA, 9-13 Mar 1986)			
28	*See* GA-A-18375	E 1.99: DE86010685	MN -20f	11:35226
CONF-860375-	(Lunar and planetary science conference, Houston, TX, USA, 17-21 Mar 1986)			
2	*See* LA-UR-86-1524	E 1.99: DE86011268	MN -34B	11:35014
3	*See* LA-UR-86-1574	E 1.99: DE86011261	MN -34B	11:35045
CONF-860384-	(Conference on measurement of electrical quantities in pulse power systems-II, Gaithersburg, MD, USA, 5-7 Mar 1986)			
8	*See* UCRL-93261	E 1.99: DE86010980	MN -28	11:34647
CONF-860396-	(Symposium on the many facets of heavy ion fusion reactions, Argonne, IL, USA, 24-26 Mar 1986)			
8	*See* DOE/ER/40048-154-L6	E 1.99: DE86010453	MN -34C	11:35156
CONF-8603115-	(Symmetries in science II, Carbondale, IL, USA, 24-26 Mar 1986)			
1	*See* LA-UR-86-1448	E 1.99: DE86010204	MN -34D	11:35109
CONF-860412-	(13. European conference on controlled fusion and plasma heating, Schliersee, F.R. Germany, 14-18 Apr 1986)			
9	*See* GA-A-18428	E 1.99: DE86010751	MN -20	11:35227
CONF-860414-	(6. power plant dynamics, control and testing symposium, Knoxville, TN, USA, 14-16 Apr 1986)			
10	*See* KFKI-1986-11/G	DE86901414	MN -78	11:33991
CONF-860417-	(3. international symposium/workshop on irradiated fuel storage, Seattle, WA, USA, 8-10 Apr 1986)			
1	*See* EGG-M-29985	E 1.99: DE86011027	MN -85	11:34511
CONF-860421-	(2. international conference on fusion reactor materials (ICFRM-2), Chicago, IL, USA, 13-17 Apr 1986)			
42	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86010505	MN -20c	11:35282
47	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86010496	MN -20c	11:34313
48	*See* GA-A-18430	E 1.99: DE86010684	MN -20c	11:34275
CONF-860425-	(191. American Chemical Society national meeting, New York, NY, USA, 13-18 Apr 1986)			
23	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE86009498	MN -22	11:34378
32	*See* PNL-SA-13597	E 1.99: DE86011136	MN -90a	11:34460
CONF-860435-	(Atomic and molecular physics conference, Aberdeen, Scotland, 8-10 Apr 1986)			
30	*See* PNL-SA-13676	E 1.99: DE86011134	MN -90a	11:33656
CONF-860445-	(Materials Research Society spring meeting, Palo Alto, CA, USA, 15-18 Apr 1986)			
12	*See* SAND-86-0815C	E 1.99: DE86010963	MN -4	11:34441
13	*See* UCRL-93538	E 1.99: DE86010982	MN -25	11:34400
CONF-860447-	(American Institute of Chemical Engineers spring national meeting, New Orleans, LA, USA, 6-10 Apr 1986)			
3	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE86010524	MN -90i	11:34733
4	*See* UCRL-93783	E 1.99: DE86010786	MN -37	11:34702
CONF-8604109-	(Pacific Gas and Electric (PG&E) energy expo, Oakland, CA, USA, 29 Apr-2 May 1986)			
5	*See* PNL-SA-13767	DE86011130	MN -95	11:34169
6	*See* PNL-SA-13769	E 1.99: DE86011131	MN -95	11:34201
CONF-8604144-	(Spring meeting of the Western States Section of the Combustion Institute, Alberta, Canada, 28-30 Apr 1986)			
6	*See* DOE/FE/60181-205	E 1.99: DE86010761	MN -90	11:33643
CONF-8604147-	(3. symposium on electromagnetic launch technology, Austin, TX, USA, 20-22 Apr 1986)			
10	*See* BNL-38145	E 1.99: DE86011539	MN -38	11:34507
CONF-8604160-	(4. world filtration congress, Ostend, Belgium, 22-25 Apr 1986)			
1	*See* CEA-CONF-8263	DE86751887	MN -4	11:34377
CONF-8604165-	(International conference on heavy ion physics, Rochester, NY, USA, 21-22 Apr 1986)			
3	*See* UCRL-94606	E 1.99: DE86010983	MN -34C	11:35163
CONF-8604172-	(19. annual oil shale symposium, Golden, CO, USA, 21-22 Apr 1986)			
2	*See* UCRL-94493	E 1.99: DE86010787	MN -91	11:33738
CONF-8604173-	(Neural nets and computation conference, Snowbird, UT, USA, 1 Apr 1986)			
1	*See* LA-UR-86-1179	E 1.99: DE86010171	MN -32	11:35373
CONF-8604176-	(Workshop on scientific applications and algorithm design for high speed computing, Champaign, IL, USA, 7-10 Apr 1986)			
1	*See* LA-UR-86-1279	E 1.99: DE86010182	MN -32	11:35246
CONF-8604183-	(Conference on molecular biology of DNA repair, Manchester, UK, 16-18 Apr 1986)			
1	*See* UCRL-94305	E 1.99: DE86010564	MN -48	11:34867
CONF-8604184-	(Symposium on 10 years of uranium beam, Darmstadt, F.R. Germany, 2-4 Apr 1986)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86010504	MN -28	11:34628

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CONF-8604185-	(2. symposium on analytic techniques for energy, natural resources, and environmental planning, Philadelphia, PA, USA, 3-4 Apr 1986)			
1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE86010509	MN -98	11:34119
CONF-860501-	(Conference on the science and technology of fast reactor safety, Channel Islands, UK, 12-16 May 1986)			
3	*See* SAND-85-1279C	TI86010957	MN -79p	11:34073
5	*See* SAND-85-1274C	TI86011186	MN -79p	11:34072
CONF-860507-	(3. workshop on integrity of containments for nuclear power plants, Washington, DC, USA, 21-23 May 1986)			
3	*See* SAND-86-0704C	TI86010954	MN -78	11:34074
4	*See* SAND-86-1114C	TI86010993	MN -78	11:34020
5	*See* SAND-86-1089C	TI86010958	MN -78	11:33975
CONF-860508-	(8. symposium on biotechnology for fuels and chemicals, Gatlinburg, TN, USA, 13-16 May 1986)			
2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86011062	MN -90d	11:33495
CONF-860510-	(Symposium on heavy ion fusion, Washington, DC, USA, 27-29 May 1986)			
4	*See* SAND-86-1083C	E 1.99: DE86011423	MN -21	11:35313
5	*See* LA-UR-86-1810	E 1.99: DE86011243	MN -21	11:35302
CONF-860520-	(Conference on charged particle optics, Los Alamos, NM, USA, 19-21 May 1986)			
1	*See* SLAC-PUB-3942	E 1.99: DE86010851	MN -28	11:34615
CONF-860522-	(7. international conference on plasma surface interactions in controlled fusion devices, Princeton, NJ, USA, 5-9 May 1986)			
3	*See* LA-UR-86-1809	E 1.99: DE86011226	MN -20f	11:35247
4	*See* UCLA/PPG-968	E 1.99: DE86010914	STD -20f	11:35322
5	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86011069	MN -20	11:35215
6	*See* SAND-85-2736C	E 1.99: DE86011420	MN -20c	11:35311
7	*See* SAND-85-2735C	E 1.99: DE86011419	MN -20a	11:35310
8	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86011509	MN -20	11:35283
9	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86011500	MN -20b	11:35284
10	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86011505	MN -20a	11:35216
CONF-860527-	(41. annual Purdue industrial waste conference, West Lafayette, IN, USA, 13-15 May 1986)			
1	*See* DOE/FE/60181-173	E 1.99: DE86010578	MN -90c	11:33567
CONF-860531-	(Annual meeting of the Association of American Geographers, Minneapolis, MN, USA, 4-7 May 1986)			
2	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE86011073	MN -13	11:34161
CONF-860551-	(Technical meeting and workshop on fusion reactor design and technology, Yalta, USSR, 26 May-6 Jun 1986)			
4	*See* UCRL-94323	E 1.99: DE86010947	MN -21	11:35327
5	*See* UCRL-94321	E 1.99: DE86010945	MN -21	11:35325
6	*See* UCRL-94322	E 1.99: DE86010946	MN -21	11:35326
CONF-860590-	(Symposium on computer modeling of fabrication processes and constitutive behavior of metals, Ottawa, Canada, 15-16 May 1986)			
2	*See* LA-UR-86-1581	E 1.99: DE86011260	MN -25	11:34282
CONF-860594-	(ASM international trends in welding research meeting, Gatlinburg, TN, USA, 18-22 May 1986)			
2	*See* SAND-85-2521C	E 1.99: DE86010955	MN -25	11:34287
4	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86011510	MN -25	11:34263
CONF-8605105-	(32. annual Institute of Environmental Sciences technical meeting, Dallas, TX, USA, 6-8 May 1986)			
1	*See* SAND-86-2069C	E 1.99: DE86010101	MN -11	11:34504
CONF-8605107-	(Symposium on productivity of northern forests following biomass harvesting, Burlington, NH, USA, 1-2 May 1986)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86010040	MN -11	11:34803
CONF-8605110-	(OPTO '86 conference, Paris, France, 13-15 May 1986)			
2	*See* LA-UR-86-1525	E 1.99: DE86011267	MN -38	11:34554
CONF-8605111-	(Northeast regional meeting on semiconductor-based heterostructure interfacial structure and stability, Murray Hill, NJ, USA, 1-2 May 1986)			
1	*See* SAND-86-0031C	E 1.99: DE86009853	MN -25	11:34361
CONF-8605113-	(Conference on ballistic missile defense and arms control, Washington, DC, USA, 12-13 May 1986)			
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86010618	MN -41	11:35392
CONF-8605114-	(Properties and applications of metal hydrides, Maubuisson, France, 25-30 May 1986)			
2	*See* MLM-3357-OP	E 1.99: DE86011336	MN -25	11:34318
CONF-860604-	(International symposium on the packaging and transport of radioactive materials (PATRAM '86), Davos, Switzerland, 16-20 Jun 1986)			
12	*See* SAND-86-0055C	E 1.99: DE86010992	MN -71	11:34522
15	*See* SAND-86-1236C	E 1.99: DE86011057	MN -71	11:34523
CONF-860606-	(Air Pollution Control Association annual meeting and exhibition, Minneapolis, MN, USA, 22-27 Jun 1986)			
2	*See* UCRL-94388	E 1.99: DE86009400	MN -11	11:34729

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3	*See* BNL-37958	E 1.99:	DE86010539	MN -11	11:34732
CONF-860612-	(4. AIAA/ASME thermophysics and heat transfer conference, Boston, MA, USA, 2-4 Jun 1986)				
7	*See* LA-UR-86-1707	E 1.99:	DE86011212	MN -38	11:34573
CONF-860615-	(Renewable energy conference, Winnipeg, Canada, 23-26 Jun 1986)				
1	*See* DOE/FE/60181-180	E 1.99:	DE86010577	MN -90c	11:33568
CONF-860620-	(Society of Photo-Optical Instrumentation Engineers international symposium: topics in optical and optoelectronic applied sciences and engineering, Quebec City, Canada, 2-6 Jun 1986)				
1	*See* LA-UR-86-1504	E 1.99:	DE86011269	MN -4	11:34459
2	*See* LA-UR-86-1617		DE86011255	MN -37	11:34698
CONF-860625-	(American Society of Civil Engineers meeting on advancements in aerodynamics, fluid mechanics and hydraulics, Minneapolis, MN, USA, 3-5 Jun 1986)				
2	*See* SAND-85-2797C		DE86010988	MN -38	11:34574
CONF-860629-	(Linear accelerator conference, Stanford, CA, USA, 2-6 Jun 1986)				
2	*See* EGG-10282-2090	E 1.99:	DE86010664	MN -28	11:34610
3	*See* LA-UR-86-1601	E 1.99:	DE86011257	MN -28	11:34641
4	*See* LA-UR-86-1587	E 1.99:	DE86011259	MN -28	11:34640
5	*See* LA-UR-86-1683	E 1.99:	DE86011247	MN -28	11:34623
6	*See* LA-UR-86-1718	E 1.99:	DE86011214	MN -28	11:34642
7	*See* LA-UR-86-1719	E 1.99:	DE86011215	MN -28	11:34612
8	*See* LA-UR-86-1733	E 1.99:	DE86011217	MN -28	11:34613
CONF-860634-	(Joint symposium on dry SO/sub 2/ and simultaneous SO/sub 2//NO/sub x/ control technologies, Raleigh, NC, USA, 2-6 Jun 1986)				
1	*See* DOE/FE/60181-178	E 1.99:	DE86010901	MN -90	11:33642
CONF-860649-	(6. annual gasification contractors' meeting, Morgantown, WV, USA, 24-25 Jun 1986)				
1	*See* LA-UR-86-1887	E 1.99:	DE86011227	MN -90c	11:33552
CONF-860665-	(6. international conference on high power particle beams, Kobe, Japan, 9-12 Jun 1986)				
1	*See* SAND-85-2738C	E 1.99:	DE86010986	MN -21	11:35312
CONF-860688-	(32. NASA/US Army international power sources symposium, Cherry Hill, NJ, USA, 8-12 Jun 1986)				
1	*See* SAND-86-2092C	E 1.99:	DE86010956	MN -94cb	11:34109
2	*See* SAND-85-2284C	E 1.99:	DE86010962	MN -94cb	11:34108
CONF-8606101-	(5. international conference on ion beam modification of materials, Catania, Italy, 9-11 Jun 1986)				
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CONF-860704-	(6. CERI world hydrogen energy conference, Vienna, Austria, 20-24 Jul 1986)				
1	*See* LA-UR-85-3023	E 1.99:	DE85017534	MN -94d	11:33875
CONF-860705-	(IEEE Power Engineering Society summer meeting, Mexico City, Mexico, 20-25 Jul 1986)				
1	*See* LA-UR-86-188	E 1.99:	DE86006019	MN -97	11:34593
2	*See* HEDL-SA-3480-FP	E 1.99:	DE86009413	MN -79i	11:34002
CONF-860706-	(23. annual conference on nuclear and space radiation effects, Providence, RI, USA, 20-23 Jul 1986)				
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CONF-860712-	(International conference on vibration problems in engineering, Xian, China, 17-20 Jul 1986)				
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CONF-860722-	(ASME pressure vessel and piping conference and exhibit, Chicago, IL, USA, 20-24 Jul 1986)				
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8	*See* EGG-M-29685		TI86009097	MN -78	11:34018
9	*See* EGG-M-29585		TI86009077	MN -78	11:34040
CONF-860724-	(ASME/ANS bi-annual nuclear power conference: safe and reliable nuclear power plants, Philadelphia, PA, USA, 20-23 Jul 1986)				
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CONF-860729-	(Summer computer simulation conference, Reno, NV, USA, 28-30 Jul 1986)				
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CONF-860739-	(11. international pyrotechnics seminar, Vail, CO, USA, 7-11 Jul 1986)			
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CONF-860740-	(Syracuse University Minnowbrook workshop on data base machines, Blue Mountain Lake, NY, USA, 22-25 Jul 1986)			
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CONF-860742-	(12. international congress on acoustics, Toronto, Canada, 24-31 Jul 1986)			
1	*See* UCRL-93820	E 1.99: DE86006701	MN -34	11:35209
CONF-860743-	(21. microwave power symposium, Memphis, TN, USA, 28-30 Jul 1986)			
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DOE/MA-0221	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99: DE86010796	STD -13	11:35353
0223	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE86010855	MN -13	11:35354
DOE/MC/19314-2046	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86010084	STD -90g	11:34177
DOE/MC/19392-1721	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE85008611	STD -90c	11:33520
DOE/MC/20404-2059	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE86006967	MN -90b	11:33644
DOE/MC/20700-2056	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99: DE86010793	STD -90b	11:33634
DOE/MC/21046-1949	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86004634	STD -90c	11:33521
DOE/MC/21136-8	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE86011280	MN -92a	11:33673
DOE/MC/21179-2032	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE86001055	MN -92	11:33712
DOE/MC/21185-2042	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE86001087	STD -93	11:34179

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DOE/MC/21194-T2	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE86011410	MN -90c	11:33645
DOE/MC/21225-16	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99: DE86003764	MN -90b	11:33522
2035	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE86001082	MN -90a	11:33523
DOE/MC/21233-2010	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE86001085	MN -90e	11:33948
DOE/MC/21306-2049	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE86011094	STD -91	11:33737
DOE/MC/21351-2057	NTIS, PC A16/MF A01; 1 (GPO Dep.)	E 1.99: DE86010237	STD -90e	11:33646
DOE/MC/21391-T1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE86004466	MN -90e	11:33949
DOE/MC/22064-T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE86006897	MN -90c	11:33524
DOE/METC-86-4061	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86006605	MN -90c	11:33561
86-4062	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86006606	MN -92a	11:33674
DOE/NASA-4148-1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE86011361	STD -95	11:34316
DOE/NBB-0077	NTIS, PC A06/MF A01 (GPO Dep.)	E 1.99: DE86010493	STD -11	11:34734
DOE/NBM-6010666	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86010666	MN -4	11:34452
6010850	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE86010850	STD -95f	11:33877
DOE/NBM/CE-1075	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE86010456	MN -63	11:33893
DOE/NE-0064	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE86011387	STD -79	11:34027
0065	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99: DE86011376	STD -79	11:34510
0066	NTIS, PC A07/MF A01 (GPO Dep.)	E 1.99: DE86011405	STD -79	11:34572
0067	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99: DE86011393	STD -79	11:33973
DOE/NE/34109-T1	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE86011045	MN -78	11:34053
DOE/OR/00033-T175	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE86010836	MN -41	11:35182
T178	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE86010837	MN -25	11:34273
DOE/OR/20722-96	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE86010596	MN -11	11:33766
102	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE86010608	MN -70A	11:34813
DOE/OR/21496-3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86010917	MN -70	11:33767
DOE/PC/40803-8	NTIS, PC A99/MF A01; 1 (GPO Dep.)	E 1.99: DE86005738	MN -90d	11:33525
DOE/PC/50021-11-Vol.2	NTIS, PC A11/MF A01; 1 (GPO Dep.)	E 1.99: DE86003570	MN -90d	11:33527
11-Vol.3	NTIS, PC A11/MF A01; 1 (GPO Dep.)	E 1.99: DE86003571	MN -90d	11:33528
DOE/PC/50030-T12	NTIS, PC A16/MF A01; 4 (GPO Dep.)	E 1.99: DE86005475	STD -90d	11:33529
DOE/PC/50041-63	NTIS, PC A09/MF A01; 1 (GPO Dep.)	E 1.99: DE86007813	STD -90d	11:33530
66	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE86010746	MN -90d	11:33531
DOE/PC/50793-T14	NTIS, PC A11/MF A01; 1 (GPO Dep.)	E 1.99: DE86010801	MN -90	11:33532
DOE/PC/50800-T14	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE86007930	STD -90d	11:33536
DOE/PC/50814-T10	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE86010667	MN -90d	11:33537
DOE/PC/60264-T3	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE86009865	STD -90i	11:34735
DOE/PC/60424-T1	NTIS, PC A06; 3	DE86010671	MN -90b	11:33647
DOE/PC/60783-T3	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE86009295	MN -90d	11:33538
DOE/PC/70018-17	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE86009018	STD -90d	11:33539
DOE/PC/70787-T5	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86010922	MN -90d	11:33541
T6	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86010921	MN -90d	11:33542
DOE/PC/70790-T6	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86011175	MN -90b	11:33543
DOE/PC/70799-T6	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86010930	MN -90d	11:33544
DOE/PC/72007-T9	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE86010744	MN -90b	11:33635
DOE/PC/80009-T9	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86010687	MN -90d	11:33545
DOE/PC/80261-T4	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86011102	MN -90e	11:33648
DOE/PC/80511-T3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86010659	MN -90c	11:34604
DOE/PC/80514-03	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE86010673	MN -90a	11:33636

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DOE/PC/80521-T3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86010872	MN -90a	11:33562
DOE/PC/80525-T3	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86011488	MN -90b	11:33637
DOE/PC/80541-T2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86009063	MN -90i	11:33569
DOE/PC/80906-2	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE86010749	MN -90d	11:33546
DOE/PC/81201-T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86010609	MN -90a	11:33547
DOE/PE/70264-T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE86009524	MN -98B	11:33696
DOE/PETC/QTR-85/4	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99: DE86010843	STD -90	11:33493
DOE/PETC/TR-86/5	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE86011321	STD -90b	11:33563
DOE/PR/06010-T35	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86009349	MN -34A	11:35042
DOE/RO/00100-T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE86010569	MN -91	11:33732
DOE/SF/00515-T63	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86011144	MN -28	11:34609
DOE/SF/11564-15	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE86000290	STD -92a	11:33675
16	NTIS, PC A06/MF A01 (GPO Dep.)	E 1.99: DE86000291	STD -92a	11:33676
DOE/SF/15799-T7	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86007848	MN -66	11:33943
DOE/TIC-4585-R5	NTIS, PC A99/MF A01 (GPO Dep.)	E 1.99: DE86007602	MN -2	11:35390
11417	NTIS$6.50			11:33713
DOE-tr-6010663	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86010663	MN -41	11:34989
DOE/UMT-050425	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99: DE86010950	MN -70A	11:33854
DOT-TSC-RSPA-83-9	*See* PB-86-160900/XAB			11:33715
DPSP-85-14-2-RM	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE85016454	MN -2	11:34048
DPST-84-555	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE86010318	MN -11	11:34861
85-1-7	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86008910	MN -80	11:34049
85-611	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86010317	MN -11	11:34862
EEB-EPB-86-02	*See* LBL-20236	E 1.99: DE86011306	MN -95d	11:34191
86-04	*See* LBL-18395	E 1.99: DE86011310	MN -95d	11:34190
86-05	*See* LBL-17940	E 1.99: DE86011311	MN -95d	11:34189
EGG-2408	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99: DE86011183	STD -95f	11:34218
10282-2090	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86010664	MN -28	11:34610
EGG-M-0885	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86011036	MN -25	11:34274
29585	NTIS, PC A02/MF A01 - GPO	TI86009077	MN -78	11:34040
29685	NTIS, PC A02/MF A01 - GPO	TI86009097	MN -78	11:34018
29885	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86009098	MN -32	11:35372
29985	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE86011027	MN -85	11:34511
EGG-RTH-7171	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE86011053	MN -78	11:33981
EGG-SAAM-6398-Rev.1	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE86011035	MN -32	11:35212
EGG-TMI-7174	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86011030	MN -78	11:33982
EGG-WM-6962	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE86011029	MN -70	11:33768
7168	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE86011033	MN -70	11:33769
7175	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE86011046	MN -70	11:33770
7225	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE86011031	MN -70	11:33771
EML-446	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86011332	STD -11	11:34655
447	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86011334	STD -11	11:35172
ENEA-RT/FARE-IMM-83-1	NTIS (US Sales Only), PC A03; 3	DE86901406	MN -93A	11:34180
ENEA-RT/FIMA-82-5	NTIS (US Sales Only), PC A03/MF A01; 1	DE86901370	MN -34C	11:35158
82-6	NTIS (US Sales Only), PC A03/MF A01; 1	DE86901371	MN -34C	11:35159
82-7	NTIS (US Sales Only), PC A03/MF A01; 1	DE86901372	MN -34C	11:35160
ENEA-RT/PROT-82-13	NTIS (US Sales Only), PC A02/MF A01; 1	DE86901368	MN -41	11:33855
82-24	NTIS (US Sales Only), PC A05/MF A01; 1	DE86901367	MN -41	11:34146
EPA/440/1-85/070	*See* PB-86-161452/XAB			11:34864
EPA/450/3-85/019A	*See* PB-86-151784/XAB			11:34797
85/029A	*See* PB-86-156791/XAB			11:34798

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EPA/450/4-				
83/ 003B	*See* PB-86-148426/XAB			11:34755
85/ 005	*See* PB-85-214237/XAB			11:34796
85/ 014	*See* PB-86-121100/XAB			11:34747
EPA/600/3-				
86/ 007A	*See* PB-86-155777/XAB			11:34980
86/ 007B	*See* PB-86-155785/XAB			11:34981
EPA/600/8-				
85/ 025	*See* PB-86-146511/XAB			11:34750
85/ 025A	*See* PB-86-146529/XAB			11:34751
EPA/600/D-				
86/ 006	*See* PB-86-145539/XAB			11:34838
86/ 011	*See* PB-86-148467/XAB			11:34756
86/ 013	*See* PB-86-145786/XAB			11:34749
86/ 027	*See* PB-86-156478/XAB			11:34129
86/ 028	*See* PB-86-156312/XAB			11:34807
86/ 029	*See* PB-86-156304/XAB			11:34844
EPA/600/J-				
85/ 254	*See* PB-86-156882/XAB			11:34256
85/ 255	*See* PB-86-156890/XAB			11:34257
85/ 257	*See* PB-86-156916/XAB			11:34808
85/ 296	*See* PB-86-162468/XAB			11:34895
85/ 321	*See* PB-86-162385/XAB			11:34988
EPRI-AP-				
4054	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI85920829	ND -60	11:33946
4199	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI85920805	ND -60	11:33945
4509	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI86920289	ND -89	11:33548
4579	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI86920283	ND -90c	11:33549
4580	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI86920300	ND -90	11:33950
4589	NTIS, PC A04/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303 (GPO Dep.)	E 1.99: DE86011177	MN -90c	11:33550
EPRI-CS-				
4320	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI86920292	ND -12	11:34860
4321	NTIS, PC A07/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303 (GPO Dep.)	E 1.99: DE86011178	MN -12	11:33951
4482-Vol.1	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI86920286	ND -90i	11:33956
4482-Vol.2	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI86920299	ND -90i	11:33957
4516-Vol.1	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI86920295	ND -90h	11:33952
4516-Vol.2	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI86920288	ND -90h	11:33953
EPRI-EL-				
4501	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI86920285	ND -97a	11:33962
4540-CCM-Vol.12	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI86920306	ND -97a	11:33963
4540-CCM-Vol.13	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI86920307	ND -97a	11:33964
4540-CCM-Vol.14	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI86920308	ND -97a	11:33965
4540-CCM-Vol.15	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI86920309	ND -97a	11:33966
4567	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI86920310	ND -97	11:33954
EPRI-EM-				
4423	Research Reports Center, Box 50490 Palo Alto, CA 94303	TI86920281	ND -13	11:34187
4523-Vol.1	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI86920293	ND -95c	11:34188
4525-Vol.1	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI86920280	ND -98	11:34159
4526	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI86920302	ND -38	11:34502
4549	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI86920301	ND -95f	11:34219
4576-Vol.1	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI86920313	ND -95f	11:34220
4576-Vol.2	Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303	TI86920314	ND -95f	11:34221
4576-Vol.3	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI86920315	ND -95f	11:34222
4584	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI86920311	ND -94e	11:34102
4587	Research Reports Center, Box 50490 Palo Alto, CA 94303	TI86920312	ND -94e	11:34605

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EPRI-NP-					
4315-SR	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI86920291	ND -78	11:33983
4498-Vol.1	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI86920294	ND -78	11:34054
4532	NTIS PC E11/MF A1235; 1 - Research Reports Center, Box 50490, Palo Alto, CA 94303 (GPO Dep.)	E 1.99:	DE86010907	MN -78	11:34055
4556	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI86920318	ND -78	11:34056
4558-SR	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI86920290	ND -78	11:34057
4559	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI86920284	ND -78	11:33984
4583	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI86920287	ND -78	11:33985
4597	Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303		TI86920296	ND -78	11:33986
4600	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI86920297	ND -78	11:33987
EPRI-P-					
4411-SR	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI86920282	ND -13	11:33947
ERG-					
053	*See* PB-86-151420/XAB				11:34195
054	*See* PB-86-151412/XAB				11:34194
ESL-					
85034-TR	*See* DOE/ID/12079-133	E 1.99:	DE86009897	MN -66a	11:33940
EUR-CEA-FC-					
1243	NTIS (US Sales Only), PC A04/MF A01		DE86751881	MN -20d	11:35289
1252	NTIS (US Sales Only), PC A09/MF A01		DE86751880	MN -20g	11:35220
1266	NTIS (US Sales Only), PC A02/MF A01		DE86751876	MN -20a	11:35221
1267	NTIS (US Sales Only), PC A02/MF A01		DE86751878	MN -20a	11:35222
1269	NTIS (US Sales Only), PC A02/MF A01		DE86751882	MN -20a	11:35223
1272	NTIS (US Sales Only), PC A04/MF A01		DE86751883	MN -20g	11:35224
1274	NTIS (US Sales Only), PC A03/MF A01		DE86751877	MN -20a	11:35225
EWE-					
2552.01	NTIS (US Sales Only), PC A04/MF A01		DE86702197	MN -70	11:33772
FEI-					
1588	NTIS (US Sales Only), PC A02/MF A01		DE86702146	MN -34C	11:35161
FL/WRRC/PUB-					
87	*See* PB-86-157096/XAB				11:34847
FNAL-					
86/ 37	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE86010487	MN -41	11:34785
FNAL/Pub-					
86/ 40-A	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011024	MN -34B	11:35009
86/ 60-A	NTIS, PC A03/01; 1 (GPO Dep.)	E 1.99:	DE86011023	MN -34B	11:35192
86/ 62-A	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011022	MN -34B	11:35010
86/ 63-A	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011021	MN -34B	11:35102
86/ 66-A	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011026	MN -34B	11:35011
FNAL-TM-					
1295	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE86010782	STD -48	11:34879
1382	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011589	STD -34D	11:34656
1393	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011664	STD -34D	11:34622
FSRP-NC-					
262	*See* PB-86-152360/XAB				11:33894
268	*See* PB-86-160348/XAB				11:34173
FSRP-RM-					
261	*See* PB-86-150885/XAB				11:34760
FTD-ID(RS)T-					
1176-85	*See* AD-A-163695/0/XAB				11:34722
FWS/OBS-					
80/ 40.4	*See* PB-86-159209/XAB				11:34773
80/ 40.7	*See* PB-86-159233/XAB				11:34774
GA-A-					
18375	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86010685	MN -20f	11:35226
18428	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86010751	MN -20	11:35227
18430	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86010684	MN -20c	11:34275
GAO/NSIAD-					
86-22-BR	General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877		TI86901299	MN -11	11:34804
GAO/OGC-					
86-5	General Accounting Office, Box 6015, Gaithersburg, MD 20760		TI86901402	MN -92a	11:33711
GAO/RCED-					
86-31	US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877		TI86901387	MN -11	11:34133
86-48	General Accounting Office, Box 6015, Gaithersburg, MD 20877		TI86901389	MN -13	11:34134
86-68FS	US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877		TI86901392	MN -41	11:34126
86-82BR	US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877		TI86901401	MN -13	11:34865
86-86	General Accounting Office, Box 6015, Gaithersburg, MD 20877		TI86901395	MN -70	11:33773

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86-87BR	General Accounting Office, Box 6015, Gaithersburg, MD 20877		TI86901399	MN -98C	11:33723
86-89FS	General Accounting Office, Box 6015, Gaithersburg, MD 20877		TI86901396	MN -11	11:34135
86-98FS	US General Accounting Office, Box 6015, Gaithersburg, MD 20877		TI86901397	MN -11	11:34127
86-103	U.S. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877		TI86901384	MN -13	11:34136
86-109FS	US General Accounting Office, Box 6015, Gaithersburg, MD 20877		TI86901400	MN -90c	11:33650
GAT-T-					
3376	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86010944	MN -37	11:34695
GEND-					
041	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE86011395	STD -78	11:33774
071	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011013	STD -78	11:33988
GJ/TMC-					
27	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86010485	STD -70A	11:33856
GKN-					
84	NTIS (US Sales Only), PC A02/MF A01		DE86702182	MN -78	11:33974
GRES-					
1985	NTIS (US Sales Only), PC A02/MF A01; 1		DE86901421	MN -59B	11:33907
GRS-A-					
1029	*See* BMI-1985-094		DE86752039	MN -80	11:34050
1055	*See* BMI-1985-095		DE86752041	MN -80	11:34051
1072	*See* BMI-1985-093		DE86752040	MN -78	11:33977
GSI-					
86-1-Prepr.	NTIS (US Sales Only), PC A02/MF A01		DE86752034	MN -34A	11:35043
GTFR-					
62	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86011155	MN -20a	11:35228
HEDL-SA-					
3480-FP	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86009413	MN -79i	11:34002
IAE-					
3828/ 6	NTIS (US Sales Only), PC A02/MF A01		DE86702120	MN -20	11:35229
3928/ 6	NTIS (US Sales Only), PC A03/MF A01		DE86702121	MN -20	11:35230
4033/ 8	NTIS (US Sales Only), PC A02/MF A01		DE86702117	MN -20	11:35231
4034/ 8	NTIS (US Sales Only), PC A02/MF A01		DE86702122	MN -20	11:35290
4047/ 4	NTIS (US Sales Only), PC A02/MF A01		DE86702188	MN -77	11:34028
IAEA-SM-					
286/ 95-P	*See* SAND-86-0055C	E 1.99:	DE86010992	MN -71	11:34522
286/ 98	*See* SAND-86-1236C	E 1.99:	DE86011057	MN -71	11:34523
ICTP-IC-					
86-3	NTIS (US Sales Only), PC A02/MF A01; 1		DE86901418	MN -34D	11:35069
IFSR-					
236	*See* DOE/ET/53088-236	E 1.99:	DE86011331	MN -20	11:35219
IFVE-OEF-					
84-143	NTIS (US Sales Only), PC A02/MF A01		DE86702139	MN -34D	11:35062
IFVE-ONF-					
84-129	NTIS (US Sales Only), PC A02/MF A01		DE86702123	MN -34D	11:35070
IFVE-OTF-					
84-15	NTIS (US Sales Only), PC A02/MF A01		DE86702124	MN -34D	11:35071
IL/SGS/ENG-					
113	*See* PB-86-158433/XAB				11:33629
INDC(ITY)-					
7	*See* ENEA-RT/FIMA-82-6		DE86901371	MN -34C	11:35159
8	*See* ENEA-RT/FIMA-82-5		DE86901370	MN -34C	11:35158
9	*See* ENEA-RT/FIMA-82-7		DE86901372	MN -34C	11:35160
INIS-mf-					
9884	NTIS (US Sales Only), PC A02/MF A01		DE86752048	MN -34D	11:35103
9885	NTIS (US Sales Only), PC A05/MF A01		DE86752049	MN -25	11:34585
9886	NTIS (US Sales Only), PC A04/MF A01		DE86752052	MN -13	11:34854
10104	NTIS (US Sales Only), PC A03/MF A01		DE86702169	MN -51	11:33743
10105	NTIS (US Sales Only), PC A02/MF A01		DE86702155	MN -4	11:34406
10106	NTIS (US Sales Only), PC A03/MF A01		DE86702200	MN -2	11:34147
10107	NTIS (US Sales Only), PC A04/MF A01		DE86702194	MN -37	11:34665
10112	NTIS (US Sales Only), PC A06/MF A01		DE86702191	MN -37	11:34671
10133	NTIS (US Sales Only), PC A02/MF A01		DE86702201	MN -2	11:34058
10137	NTIS (US Sales Only), PC A06/MF A01		DE86702119	MN -20	11:35232
INP-					
1177/ PH	NTIS (US Sales Only), PC A02/MF A01		DE86702109	MN -34D	11:35108
1187/ AP	NTIS (US Sales Only), PC A03/MF A01		DE86702156	MN -4	11:34393
1201/ PL	NTIS (US Sales Only), PC A03/MF A01		DE86702204	MN -32	11:35113
INS-R-					
316	NTIS (US Sales Only), PC A02/MF A01		DE86702157	MN -4	11:34856
322	NTIS (US Sales Only), PC A02/MF A01		DE86702164	MN -4	11:34394
326	NTIS (US Sales Only), PC A02/MF A01		DE86702168	MN -51	11:34830
328	NTIS (US Sales Only), PC A04/MF A01		DE86702158	MN -4	11:34992
330	NTIS (US Sales Only), PC A02/MF A01		DE86702159	MN -4	11:34395
331	NTIS (US Sales Only), PC A02/MF A01		DE86702160	MN -4	11:34993
IOS-Rep-					
197	NTIS (US Sales Only), PC A05/MF A01		DE86751827	MN -41	11:33847
IPNO-TH-					
84-72	NTIS (US Sales Only), PC A02/MF A01		DE86751806	MN -34D	11:35080
IPP-					
5/ 7	NTIS (US Sales Only), PC A02/MF A01		DE86752033	MN -20a	11:35233

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III/ 102	NTIS (US Sales Only), PC A04/MF A01		DE86752038	MN -20a	11:35234
III/ 107	NTIS (US Sales Only), PC A05/MF A01		DE86752047	MN -20a	11:35235
IS-M-					
558	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011431	MN -90a	11:33638
569	NTIS, PC A02; 3		DE86011435	MN -90d	11:33551
ITCMPPW-					
9/ 82	NTIS (US Sales Only), PC A02/MF A01		DE86702177	MN -23	11:33873
ITEP-					
4(1985)	NTIS (US Sales Only), PC A04/MF A01		DE86702118	MN -20	11:35245
24(1985)	NTIS (US Sales Only), PC A02/MF A01		DE86702140	MN -34D	11:35063
40(1985)	NTIS (US Sales Only), PC A03/MF A01		DE86702141	MN -34D	11:35064
94(1984)	NTIS (US Sales Only), PC A02/MF A01		DE86702153	MN -34C	11:35131
98(1984)	NTIS (US Sales Only), PC A02/MF A01		DE86702151	MN -34C	11:35132
126(1984)	NTIS (US Sales Only), PC A03/MF A01		DE86702149	MN -34C	11:35133
144(1984)	NTIS (US Sales Only), PC A02/MF A01		DE86702150	MN -34C	11:35134
ITEP-					
16(1985)	NTIS (US Sales Only), PC A02/MF A01		DE86702127	MN -34D	11:35081
19(1984)	NTIS (US Sales Only), PC A02/MF A01		DE86702131	MN -34D	11:35082
28(1985)	NTIS (US Sales Only), PC A02/MF A01		DE86702132	MN -34D	11:35083
32(1985)	NTIS (US Sales Only), PC A02/MF A01		DE86702193	MN -37	11:34672
33(1984)	NTIS (US Sales Only), PC A03/MF A01		DE86702147	MN -34C	11:35165
36(1985)	NTIS (US Sales Only), PC A02/MF A01		DE86702133	MN -34D	11:35084
57(1985)	NTIS (US Sales Only), PC A02/MF A01		DE86702134	MN -34D	11:35085
59(1984)	NTIS (US Sales Only), PC A02/MF A01		DE86702112	MN -34D	11:35166
61(1985)	NTIS (US Sales Only), PC A02/MF A01		DE86702148	MN -34C	11:35167
102(1984)	NTIS (US Sales Only), PC A02/MF A01		DE86702125	MN -34D	11:35086
148(1984)	NTIS (US Sales Only), PC A03/MF A01		DE86702126	MN -34D	11:35087
164(1984)	NTIS (US Sales Only), PC A02/MF A01		DE86702128	MN -34D	11:35088
168(1984)	NTIS (US Sales Only), PC A02/MF A01		DE86702129	MN -34D	11:35089
180(1984)	NTIS (US Sales Only), PC A02/MF A01		DE86702130	MN -34D	11:35090
JA-					
57991	*See* AD-A-163913/7/XAB				11:34545
JINR-					
E-1-84-374	NTIS (US Sales Only), PC A02/MF A01		DE86702138	MN -34D	11:35065
E-4-85-352	NTIS (US Sales Only), PC A02/MF A01		DE86702144	MN -34C	11:35168
R-1-85-259	NTIS (US Sales Only), PC A02/MF A01		DE86702142	MN -34D	11:35066
R-4-85-249	NTIS (US Sales Only), PC A02/MF A01		DE86702145	MN -34C	11:35152
Juel-					
2019	NTIS (US Sales Only), PC A08/MF A01		DE86752050	MN -25	11:34277
Juel-Conf-					
52	NTIS (US Sales Only), PC A02/MF A01		DE86752042	MN -77	11:33999
54	NTIS (US Sales Only), PC A99/MF A01		DE86752037	MN -70	11:33776
Juel-Spez-					
332	NTIS (US Sales Only), PC A04/MF A01		DE86752046	MN -2	11:34151
333	NTIS (US Sales Only), PC A03/MF A01		DE86752051	MN -80	11:34059
K/OA-					
5787	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011147	MN -22	11:33752
K/TS-					
11-703	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011408	MN -38	11:33749
11-796	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011584	MN -25	11:34357
KAERI/AR-					
251/ 85	NTIS (US Sales Only), PC A06/MF A01		DE86702161	MN -4	11:33754
252/ 84	NTIS (US Sales Only), PC A04/MF A01		DE86702166	MN -86	11:33750
KAERI/MR-					
70/ 84	NTIS (US Sales Only), PC A03/MF A01		DE86702165	MN -4	11:34396
78/ 84	NTIS (US Sales Only), PC A08/MF A01		DE86780464	MN -41	11:34905
80/ 84	NTIS (US Sales Only), PC A08/MF A01		DE86702195	MN -70	11:33810
81/ 84	NTIS (US Sales Only), PC A02/MF A01		DE86702176	MN -22	11:34481
82/ 84	NTIS (US Sales Only), PC A07/MF A01		DE86702171	MN -48	11:35185
KAERI/RR-					
436/ 84	NTIS (US Sales Only), PC A13/MF A01		DE86702187	MN -78	11:34516
447/ 84	NTIS (US Sales Only), PC A09/MF A01		DE86702196	MN -70	11:33811
450/ 1/ 84	NTIS (US Sales Only), PC A08/MF A01		DE86780466	MN -48	11:34907
450/ 84	NTIS (US Sales Only), PC A23/MF A01		DE86780463	MN -80	11:34816
451-1/ 84	NTIS (US Sales Only), PC A14/MF A01		DE86702178	MN -71	11:33812
451-2/ 84	NTIS (US Sales Only), PC A09/MF A01		DE86780465	MN -70	11:33815
451-3/ 84	NTIS (US Sales Only), PC A11/MF A01		DE86702198	MN -70	11:33816
451-5/ 84	NTIS (US Sales Only), PC A13/MF A01		DE86702179	MN -71	11:34517
451/ 84	NTIS (US Sales Only), PC A05/MF A01		DE86702199	MN -70	11:33817
KFK-					
3397	NTIS (US Sales Only), PC A08/MF A01		DE86752045	MN -25	11:34279
3917	NTIS (US Sales Only), PC A04/MF A01		DE86752043	MN -25	11:34280
3918	NTIS (US Sales Only), PC A05/MF A01		DE86752044	MN -25	11:34281
4004	NTIS (US Sales Only), PC A05/MF A01		DE86752035	MN -80	11:34060
4011	NTIS (US Sales Only), PC A02/MF A01		DE86751752	MN -34D	11:35067
4017	NTIS (US Sales Only), PC A13/MF A01		DE86752036	MN -16	11:33869
KFKI-					
1986-04/ A	NTIS (US Sales Only), PC A02/MF A01; 1		DE86901294	MN -34D	11:35205
1986-05/ A	NTIS (US Sales Only), PC A03/MF A01; 1		DE86901312	MN -34D	11:35169
1986-11/ G	NTIS (US Sales Only), PC A02/MF A01; 1		DE86901414	MN -78	11:33991
1986-13/ D	NTIS (US Sales Only), PC A04/MF A01; 1		DE86901420	MN -11	11:35206
KGI-					
191	*See* PB-86-153608/XAB				11:35034

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KY/tr-					
86/ 1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86009957	MN -25	11:34306
LA-					
10659-HDR-Vol.2	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99:	DE86008160	STD -66b	11:33937
10711-MS	*See* NUREG/CR-4595		TI86011597	MN -79	11:34003
10721-ENV	NTIS, PC A10/MF A01; 1 (GPO Dep.)	E 1.99:	DE86007870	STD -41	11:34817
10726-T	NTIS, PC A06; 3		DE86011739	MN -34A	11:35044
LA-UR-					
85-3023	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85017534	MN -94d	11:33875
86-188	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86006019	MN -97	11:34593
86-428	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86005849	MN -38	11:34594
86-1179	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86010171	MN -32	11:35373
86-1216	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86010175	MN -34B	11:35013
86-1279	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86010182	MN -32	11:35246
86-1448	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86010204	MN -34D	11:35109
86-1504	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86011269	MN -4	11:34459
86-1524	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86011268	MN -34B	11:35014
86-1525	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011267	MN -38	11:34554
86-1547	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011265	MN -38	11:34555
86-1574	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011261	MN -34B	11:35045
86-1581	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011260	MN -25	11:34282
86-1587	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011259	MN -28	11:34640
86-1601	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011257	MN -28	11:34641
86-1617	NTIS, PC A02; 3		DE86011255	MN -37	11:34698
86-1682	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86011248	MN -38	11:34556
86-1683	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011247	MN -28	11:34623
86-1707	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011212	MN -38	11:34573
86-1718	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011214	MN -28	11:34642
86-1719	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011215	MN -28	11:34612
86-1733	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011217	MN -28	11:34613
86-1809	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86011226	MN -20f	11:35247
86-1810	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011243	MN -21	11:35302
86-1887	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011227	MN -90c	11:33552
LBL-					
17940	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86011311	MN -95d	11:34189
18395	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011310	MN -95d	11:34190
20236	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011306	MN -95d	11:34191
20737	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011192	MN -94cb	11:34106
20834-Rev.	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86009951	MN -28	11:34643
20847	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011312	MN -25	11:34358
21223	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011315	MN -20d	11:35303
LBL-PUB-					
445	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86011319	MN -13	11:35350
LIDS-P-					
1518	*See* AD-A-164054/9/XAB				11:35191
LJI-R-					
86-392	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86010759	MN -34D	11:34624
LW-					
8510	*See* PB-86-151685/XAB				11:34806
MASGP-					
85-018	*See* PB-86-159522/XAB				11:34131
MINTEK-M-					
238	NTIS (US Sales Only), PC A03/MF A01; 1		DE86901419	MN -90b	11:33639
MLM-					
3343	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011365	STD -38	11:34518
3349	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86008137	STD -41	11:34819
3357-OP	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011336	MN -25	11:34318
MSAR-					
81-107	*See* PB-86-156486/XAB				11:34845
MSHA/IR-					
1179	NTIS, PC A13/MF A01; 1		DE86901434	MN -41	11:34990
1181	NTIS, PC A06/MF A01; 1		DE86901436	MN -41	11:34991
1182	NTIS, PC A17/MF A01; 1		DE86901437	MN -41	11:33653
MTI-					
85TR25	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011055	MN -95f	11:34223
NASA/CR-					
175019	*See* DOE/NASA-4148-1	E 1.99:	DE86011361	STD -95	11:34316
NBSIR-					
84/ 2854	*See* PB-86-141934/XAB				11:35177
85-3202	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011517	MN -34	11:35207
85/ 3266	*See* PB-86-170719/XAB				11:33710
86/ 3305	*See* PB-86-154598/XAB				11:34762
NCTR-					
6234	*See* PB-86-150828/XAB				11:34759
NDRL-					
2842	*See* DOE/ER/00038-2842	E 1.99:	DE86010668	MN -4	11:34466
NEFES-					
86-13	*See* PB-86-158698/XAB				11:34772
NIKHEF-K-LINO-					
109	NTIS (US Sales Only), PC A03/MF A01		DE86702180	MN -28	11:34644
NIPER-					
73	NTIS, PC A12/MF A01; 1 (GPO Dep.)	E 1.99:	DE86010845	MN -92b	11:33698
126	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86011487	MN -92a	11:33677
147	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011281	MN -92	11:33678

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NOAA-TM-ERL-ARL-				
140	*See* PB-86-148277/XAB			11:34754
141	*See* PB-86-158409/XAB			11:34771
NP-				
6751996	NTIS (US Sales Only), PC A04/MF A01; 1	DE86751996	MN -95f	11:34224
6901348	NTIS (US Sales Only), PC A10/MF A01; 1	DE86901348	MN -61E	11:33883
6901362	L.W.V.E.T., Nick Lyons Books, 31 W. 21st St., New York, NY 10010	TI86901362	ND -70	11:34155
6901422	NTIS (US Sales Only), PC A15/MF A01; 1	DE86901422	MN -38	11:34595
NP-tr-				
6901439	NTIS (US Sales Only), PC A02/MF A01; 1	DE86901439	MN -94c	11:34118
NPS-				
74-85-002	*See* AD-A-163865/9/XAB			11:35355
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1984/ 1	NTIS (US Sales Only), PC A02/MF A01	DE86702170	MN -48	11:35186
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5651	*See* AD-A-163604/2/XAB			11:35278
NRL-REPRINT-				
24-53	*See* AD-A-955044/3/XAB			11:35171
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0040-Vol.10-No.1	NTIS, PC A08/MF A01 - GPO	TI86901432	MN -2	11:34015
0540-Vol.8-No.3	NTIS, PC A20/MF A01 - GPO	TI86901412	MN -2	11:34152
0750-Vol.23-No.3	NTIS, PC A07/MF A01 - GPO	TI86901443	MN -2	11:34153
0797-Suppl.13	NTIS, PC A04/MF A01 - GPO	TI86901459	MN -78	11:34061
0837-Vol.5-No.4	NTIS, PC A14/MF A01 - GPO	TI86901411	MN -41	11:34820
0954-Suppl.6	NTIS, PC A02/MF A01 - GPO	TI86901429	MN -78	11:34062
1057-Suppl.1	NTIS, PC A05/MF A01 - GPO	TI86901442	MN -78	11:34063
1175	NTIS, PC A03/MF A01 - GPO	TI86901361	MN -41	11:34064
1191	NTIS, PC A24/MF A01 - GPO	TI86901440	MN -78	11:33992
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3262-Vol.7	NTIS (US Sales Only), PC A11/MF A01 - GPO	TI86010802	MN -78	11:34065
3702	NTIS, PC A13/MF A01 - GPO	TI86901449	MN -78	11:34066
3770	NTIS, PC A99/MF A01 - GPO	TI86011205	MN -78	11:34067
3805-Vol.3	NTIS, PC A13/MF A01 - GPO	TI86901156	MN -80	11:34068
3882	NTIS, PC A04/MF A01 - GPO	TI86010156	MN -11	11:34795
4290-Vol.1	NTIS, PC A04/MF A01 - GPO	TI86011174	MN -78	11:34069
4519	NTIS, PC A03/MF A01 - GPO	TI86011208	MN -70	11:33818
4549	NTIS, PC A06/MF A01 - GPO	TI86010756	MN -78	11:34070
4580	NTIS, PC A06/MF A01 - GPO	TI86901342	MN -11	11:34996
4581	NTIS, PC A04/MF A01 - GPO	TI86901430	MN -78	11:34071
4584	NTIS, PC A03/MF A01 - GPO	TI86010923	MN -78	11:33993
4595	NTIS, PC A02/MF A01 - GPO	TI86011597	MN -79	11:34003
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84-18-Vol.6	NTIS, PC A13/MF A01; 1 (GPO Dep.)	E 1.99: DE86010654	MN -66	11:33938
NZGS-G-				
79	NTIS (US Sales Only), PC A02/MF A01	DE86702162	MN -4	11:34994
NZGS-PAL-				
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85/ 0103	*See* PB-86-148376/XAB			11:33708
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6260	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE86011343	MN -32	11:35375
6262	*See* DOE/NASA-4148-1	E 1.99: DE86011361	STD -95	11:34316
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86/ 2	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE86011353	STD -20c	11:35305
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84-43366/ 2	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE86011296	MN -95d	11:34360
85-00219/ 1	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99: DE86011289	MN -95d	11:34225
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6345/ R2	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE86011348	MN -80	11:34041
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9694	NTIS, PC A03; 3	DE86011355	MN -70	11:33820
9724	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE86011344	STD -97a	11:33967

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9803	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE86011360	STD -86	11:33758
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10049	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86011291	MN -90h	11:34284
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86/ 6	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86009677	MN -34	11:35056
86/ 8	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE86011103	MN -59A	11:34203
86/ 19	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE86011474	MN -38	11:34589
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83-252098	*See* DOE/ER/10082-T1-Vol.3	E 1.99: DE86010651	MN -66a	11:33934
84-153162	*See* DOE/ER/10082-T1-Vol.4	E 1.99: DE86010652	MN -66a	11:33933
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5613	*See* DOE/CH-17	E 1.99: DE86010857	MN -70	11:34997
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5780	NTIS, PC A09/MF A01; 1 (GPO Dep.)	E 1.99: DE86010858	MN -70	11:33823
5805	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE86011015	MN -90d	11:33554

Report Number	*Availability Source*	*File Number*		*Distribution Category*	*Abstract Number*
5866	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011542	MN -95c	11:34168
5867	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE86010489	MN -11	11:34828
PNL-SA-					
12650	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86010939	MN -41	11:34940
12937	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011325	MN -4	11:34398
13096	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86010937	MN -95d	11:34200
13349	NTIS, PC A03/MF A01; 1		TI86011324	MN -25	11:34286
13364	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011141	MN -70	11:33824
13415	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86010934	MN -85	11:33825
13418	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86011116	MN -90d	11:33655
13597	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86011136	MN -90a	11:34460
13676	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86011134	MN -90a	11:33656
13767	NTIS, PC A02; 3		DE86011130	MN -95	11:34169
13769	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86011131	MN -95	11:34201
PPES-					
86-1	*See* PB-86-163102/XAB				11:34799
PPPL-					
2153R	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011169	STD -20g	11:35248
2262	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE86011358	STD -20g	11:35249
2319	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE86011165	STD -20g	11:35250
2323	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86011170	STD -20g	11:35251
2325	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011164	STD -20a	11:35252
2326	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86011171	STD -20g	11:34558
2327	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011173	STD -20b	11:35253
2328	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011161	STD -20f	11:35254
2329	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86011364	STD -20g	11:35255
2331	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011370	STD -20g	11:35256
2333	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011172	STD -20f	11:35306
2335	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011163	STD -20a	11:35257
2337	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86011168	STD -20g	11:35258
2338	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86011359	STD -20a	11:35259
2339	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86011167	STD -20f	11:35260
2341	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011362	STD -20f	11:35307
2343	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011369	STD -20g	11:35261
2345	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011149	STD -20e	11:35308
PWA-					
34/ 85	*See* KFK-3918		DE86752044	MN -25	11:34281
QIFEL-					
004/ 80	*See* AD-A-164471/5/XAB				11:34551
021/ 83	*See* AD-A-164366/7/XAB				11:34547
022/ 83	*See* AD-A-164339/4/XAB				11:34546
026/ 83	*See* AD-A-164499/6/XAB				11:34552
027/ 84	*See* AD-A-164455/8/XAB				11:34550
030/ 84	*See* AD-A-164513/4/XAB				11:34553
RAL-					
86-007	Rutherford Appleton Lab., Chilton, Didcot, Oxon, 0X11 0QX England		TI86901310	ND -28	11:34673
RCM-					
02085	NTIS (US Sales Only), PC A03/MF A01		DE86751410	MN -11	11:34858
REPT-					
87	*See* PB-86-161684/XAB				11:33651
1984-04	*See* PB-86-154275/XAB				11:34557
84252	*See* PB-86-163730/XAB				11:33725
2311205871	*See* PB-86-156122/XAB				11:33730
RFP-					
3963	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86010809	MN -10	11:34399
3965	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86010810	MN -70	11:33826
3977	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86010804	MN -70	11:33827
RFP-ENV-					
83	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE86010406	MN -11	11:34821
RHO-BW-CR-					
144-P	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99:	DE86010967	MN -70	11:33848
RHO-HS-SR-					
85-3-4Q-LIQ-P	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99:	DE86010001	MN -11	11:34824
RHO-RE-TR-					
4	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86010661	MN -86	11:33829
RISOE-					
304-44	Forsoegsanlaeg Risoe, Roskilde, Denmark				11:33649
SAIC-					
86/ 1024	*See* AD-A-163724/8/XAB				11:33686
SAND-					
81-6003	NTIS$5.00				11:33555
85-1274C	NTIS, PC A02/MF A01 - GPO		TI86011186	MN -79p	11:34072
85-1279C	NTIS, PC A02/MF A01 - GPO		TI86010957	MN -79p	11:34073
85-2099	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86011545	MN -37	11:34699
85-2284C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86010962	MN -94cb	11:34108
85-2403	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011016	MN -13	11:34503
85-2521C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86010955	MN -25	11:34287
85-2585	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011546	MN -20a	11:35309
85-2735C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011419	MN -20a	11:35310
85-2736C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86011420	MN -20c	11:35311
85-2738C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86010986	MN -21	11:35312
85-2787C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86010990	MN -45	11:34714
85-2788C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86010991	MN -45	11:34715

Report Number	Availability Source	File Number		Distribution Category	Abstract Number
85-2797C	NTIS, PC A02; 3		DE86010988	MN -38	11:34574
85-2798C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86009626	MN -38	11:34519
85-2806	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE86010632	MN -70	11:35005
85-2812	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86010313	MN -13	11:34586
85-2813C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86010996	MN -45	11:34716
85-2814C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86010995	MN -38	11:34520
85-2864C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86010477	MN -38	11:34521
85-2872C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86010987	MN -4	11:34496
85-8019	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86010779	MN -62a	11:33902
85-8181	NTIS, PC A15/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011380	MN -62a	11:33903
85-8247	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011379	MN -25	11:34288
86-0031C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86009853	MN -25	11:34361
86-0055C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86010992	MN -71	11:34522
86-0258C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86006466	MN -34	11:35046
86-0259	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011543	MN -13	11:35378
86-0280C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86006464	MN -23	11:34690
86-0308C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86006459	MN -37	11:34691
86-0309C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86006463	MN -23	11:34692
86-0340C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86007709	MN -38	11:34596
86-0341C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86007710	MN -38	11:34597
86-0358C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86007143	MN -37	11:34700
86-0448C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86007700	MN -37	11:34693
86-0499C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86007821	MN -32	11:35379
86-0509	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011150	MN -25	11:34587
86-0564	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE86011672	MN -32	11:35380
86-0626	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86011544	MN -25	11:34344
86-0704C	NTIS, PC A02/MF A01 - GPO		TI86010954	MN -78	11:34074
86-0815C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86010963	MN -4	11:34441
86-1083C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011423	MN -21	11:35313
86-1089C	NTIS, PC A02/MF A01 - GPO		TI86010958	MN -78	11:33975
86-1114C	NTIS, PC A02/MF A01 - GPO		TI86010993	MN -78	11:34020
86-1236C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011057	MN -71	11:34523
86-2069C	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86010101	MN -11	11:34504
86-2075C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86010476	MN -38	11:34524
86-2092C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86010956	MN -94cb	11:34109
86-7032	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011017	MN -63	11:33895
86-8217	NTIS, PC A10/MF A01; 1 (GPO Dep.)	E 1.99:	DE86010864	MN -93	11:34575
SBD-					
4889	NTIS (US Sales Only), PC A02/MF A01		DE86702175	MN -41	11:35187
SERI/SP-					
271-2796	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE85012168	STD -64	11:33906
273-2938	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99:	DE86004441	MN -62	11:33904
SERI/STR-					
211-2858	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86004437	STD -63	11:33896
211-2910	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE86004450	STD -63	11:33897
211-2923	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE86004449	STD -63	11:33898
217-2915	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86004459	MN -62	11:33905
SERI/TR-					
253-2736	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE86004433	MN -62a	11:33925
SGD-					
494-PT-1	*See* PB-86-143245/XAB				11:35015
494-PT-2	*See* PB-86-143252/XAB				11:35016
496-PT-1	*See* PB-86-156866/XAB				11:35017
496-PT-2	*See* PB-86-156874/XAB				11:35018
SLAC-					
102	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011098	MN -28	11:34614
297	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86008139	STD -32	11:35381
SLAC/AP-					
44	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011489	MN -28	11:34645
52	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011146	MN -28	11:34525
SLAC-CN-					
328	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86011145	MN -28	11:34646
330	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86011516	MN -28	11:34625
SLAC-PUB-					
3891	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86009781	MN -28	11:34626
3909	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86009780	MN -34D	11:35110
3911	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86009778	MN -34D	11:35091
3942	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86010851	MN -28	11:34615
3951	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011158	MN -34D	11:35092
SOL-					
86-6	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011330	MN -32	11:35382
SRD-					
85-027	*See* DOE/ET/14928-12	E 1.99:	DE86004814	MN -90c	11:33517
SRD-R-					
314	United Kingdom Atomic Energy Authority, Wigshaw Lone, Culcheth Warrington, Waz 4NE		TI86901413	ND -92	11:33731
SSI-TR-					
1900/ 201	*See* UCRL-15800	E 1.99:	DE86010551	MN -32	11:35385
SSS-R-					
85-7145	*See* UCRL-15760	E 1.99:	DE86008150	MN -11	11:34723
SUPRI-TR-					
49	*See* DOE/SF/11564-15	E 1.99:	DE86000290	STD -92a	11:33675
51	*See* DOE/SF/11564-16	E 1.99:	DE86000291	STD -92a	11:33676

Report Number	Availability Source	File Number		Distribution Category	Abstract Number
TOP-					
8-4-005	*See* AD-A-163640/6/XAB				11:35351
TP-					
840118	Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096				11:34248
840360	Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096				11:34251
840366	Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096				11:34246
840375	Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096				11:34245
840377	Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096				11:34247
840378	Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096				11:34244
850227	Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096				11:34250
851189	Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096				11:34243
TPJU-					
2/ 82	*See* INP-1177/PH		DE86702109	MN -34D	11:35108
TR-					
9	*See* AD-A-164444/2/XAB				11:34549
11	*See* AD-A-164376/6/XAB				11:34548
0084A(5764) -1	*See* AD-A-163529/1/XAB				11:34542
0086(6940-05) -2	*See* AD-A-163716/4/XAB				11:35025
0086(6940-05) -12	*See* AD-A-163654/7/XAB				11:35024
TRB/NCHRP/SYN-					
121	*See* PB-86-154192/XAB				11:34209
TT-					
80-52013	*See* PB-86-156361/XAB				11:34305
TVA/OACD-					
85/ 8-1-85	NTIS, PC A04; 3		DE86009656	MN -61	11:33884
TVA/PE/EDT-					
85/ 25	NTIS, PC A03/MF A01; 1		DE86901138	MN -80	11:34289
UCID-					
20047-Rev.1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE86010660	MN -4	11:34442
20228	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86010862	MN -20	11:35314
20229	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86010863	MN -20d	11:35315
20230	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86010859	MN -20d	11:35316
20231	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86010861	MN -20	11:35317
20232	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86010860	MN -20	11:35318
20233	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011009	MN -20d	11:35319
20275	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011006	MN -32	11:34505
20308	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86010783	MN -11	11:34859
20489	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011011	MN -4	11:34482
20664	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE86010492	MN -32	11:35383
20716	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE86009164	MN -11	11:34810
20737	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86010781	MN -4	11:34717
20744	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE86010780	MN -34A	11:35047
20755	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011007	MN -28	11:34616
20760	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86010777	MN -11	11:34701
20764	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011692	MN -38	11:34526
20771	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86011700	MN -92b	11:33719
UCLA/PPG-					
902	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86010913	STD -20g	11:35262
916	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011441	STD -20g	11:35263
941	NTIS, PC A03/MF A01; 4 (GPO Dep.)	E 1.99:	DE86010612	STD -20a	11:35264
949	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86010613	STD -20a	11:35265
964	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE86010614	STD -20a	11:35320
967	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86010911	STD -20c	11:35321
968	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86010914	STD -20f	11:35322
UCRL-					
15688	NTIS, PC A12/MF A01; 1 (GPO Dep.)	E 1.99:	DE86010561	MN -41	11:33860
15760	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE86008150	MN -11	11:34723
15787	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86009701	MN -11	11:34778
15797	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86011513	MN -32	11:35384
15800	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86010551	MN -32	11:35385
15801	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE86010969	MN -70	11:33828
15806-Rev.1	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99:	DE86010789	MN -20	11:35323
15807	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86010555	MN -11	11:34779
15808	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86010554	MN -11	11:34780
15810	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86010553	MN -11	11:34725
15811	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86010550	MN -11	11:34998
50016-85-1	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE86011356	STD -38	11:34506
50025-86-1	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86011371	STD -38	11:34598
53644-Vol.1	*See* NUREG/CR-4290-Vol.1		TI86011174	MN -78	11:34069
53673	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86010778	MN -70	11:34999
53674	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86010267	STD -11	11:34829
53697	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011366	STD -21	11:35324
91765	*See* PB-86-142320/XAB				11:34857
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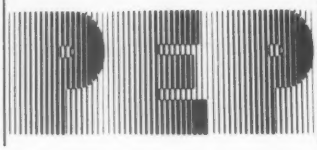

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